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The COMMONSENSE OF HEALTH

STANLEY M. RINEHART, M.D.

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THE COMMONSENSE OF HEALTH

STANLEY M. RINEHART, M.D.

The Commonsense of Health

by

STANLEY M. RINEHART, M.D.

CANCELLED

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THE COMMONSENSE OF HEALTH
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THE COMMONSENSE OF HEALTH

THE COMMONSENSE OF HEALTH

ONE

ON CATCHING COLD

TO speak of catching cold is misleading. The fact is, one cannot catch cold if he tries. A cold is the most elusive thing in the world. One may expose himself to all kinds of weather—dry, rainy, freezing, hot—and to several different varieties on the same day, without catching cold.

And then some day when he is totally unaware, when conditions are perhaps not more unfavorable than usual, a cold catches him. Then if he tries to overtake it he will realize how difficult it is to catch. An express train after it has left the station is not harder to overtake than a cold.

Everyone treats a cold with levity—that is, everyone but the victim. He is such a sorry figure that he is an object for the shafts of wit of all his acquaintances. His eyes are watery, his nose is red, he sneezes and blows incessantly and he talks through his nose.

But however humorous his condition may seem to others, the victim is miserable. He has a stuffy, smothered sensation, extreme dryness of the mouth and throat, and extreme moisture of the eyes and nose, which are a complete reversal from the normal condi-

tions. And he has lost his taste for food, his taste for tobacco, even his taste for his friends.

And everyone he meets offers a suggestion as to a cure. If one were to go home at noon and follow all the directions that he has received in a single morning he would be cured—that is, he would never have another cold; nor anything else. But of course he does nothing of the kind. He doesn't even listen to the importunities of officious acquaintances. Indeed he is too miserable to do anything but weep and sneeze and hack and blow; and shiver with the little chills that creep up and down his back; and wonder why he has been so attacked by Fate.

Because everybody, sometime or another, has the same experience, and especially because everybody wonders how it all came about, this is written. It may be of some use to inquire how a cold happens, what it is, and what may be done to avoid it. But of course there is no hope, implied or expressed, that after this article is published people will stop having colds. That would be impossible. If by following the precepts here set down one cold can be made to grow where two grew before, the article's mission will have been fulfilled.

Galen, whose writings were an authority on medicine for many centuries, said that coryza, or the nasal fluid that always accompanies a cold in the head, was a secretion from the brain. This unique theory was exploded long ago. But the fact is that until a comparatively short time ago, when certain microörganisms that frequent the nose were discovered, very little was known of the causes of the common cold.

Not that bacteria are the only cause. There are other causes, as we shall see, and over some of these

we have control. Which, as has been intimated, is the reason for this article.

The nose has three essential functions, which are in brief: Olfactory, respiratory and vocal. It is used to smell with, to breathe through, and, with certain accessory chambers, as a sounding box in speaking or singing.

To begin with the function which is of least importance to our present purpose, if it were not for the nose and the accessory chambers the human voice would be lifeless, dull, without overtones, those vibrant qualities so pleasing to the listening ear—that is, in some voices.

When one has a cold or, rather, when a cold has one, the mucous membrane which lines the nose and the accessory sinuses, as they are called, becomes swollen and the overtones cease. The sound waves, shut off from the sounding boxes, have their exit through the mouth only. Then one talks through his nose, which is exactly what he does not do. One talks without the help of his nose.

A cold, then, changes the quality of the voice. If that were all one could stand it. But another function of the nose is more essential to enjoyment of life. The nose contains the terminal filaments of the olfactory nerve, the nerve of smell. All odors, good or bad, are detected there. This nerve enables us to discriminate not only between that which is pleasing and that which is unpleasant, but it guards us against dangers lurking in the air.

What concerns us most at present is that the sense of smell has a great deal to do with taste. All savors are perceived through the nose. The nerve of taste, distributed over the base of the tongue, enables us to

distinguish sweet from sour or bitter, but all the finer shades of flavor are dependent upon smell.

When the mucous membrane lining the nose is swollen the olfactory filaments are pinched and deadened. Then if we shut our eyes we cannot tell soup from soap, which is a great loss and adds tremendously to the discomfort.

But the most important function of the nose is that of respiration. Man was not intended to breathe through his mouth. The nose is the front door of the lungs. And the air stream does not pursue a straight course, but winds deviously through passages, over projecting shelves, and when it reaches the lungs it has changed considerably.

To begin with, atmospheric air is usually too dry. It must be moistened in its passage. Whatever the humidity of the respired air the nose either adds to or substracts from it moisture, so as to make it right for the lungs. The mucous membrane of the nose supplies to inspired air about a quart of water a day.

And the temperature must be raised. Cold air is injurious to the lungs. In its passage through the nose the temperature must be raised approximately to that of the blood.

Also the air must be filtered, freed from irritating particles of dust and from germs. Very little dirt gets into the lungs of a nose breather; and almost no germs. At the openings, the nostrils, there are hairs to catch the grosser particles of dirt. And farther within the mucous membrane has an outer coat of what is called ciliated epithelium, whose minute cilia wave constantly toward the front door, catching the minutest foreign matter in the air streams and waving it gently but insistently back toward the door through

which it entered. Then the mucous membrane itself has what is called an inhibitory action upon inimical germs, rendering them harmless. And so, though innumerable germs get into the nose they do not get very far. They crowd in great numbers in the vestibule. And those that push onward any distance are returned, harmless, to the port of entry.

This is why the nose breather has so much better chance, so much greater expectancy of life and happiness, than the mouth breather. One can realize the tremendous task the nose has to perform if one remembers that about twenty-five hundred gallons of air pass through it—or should pass through it—in twenty-four hours. And it has been estimated that at least fourteen thousand organisms enter the front door during an hour's quiet respiration.

When one takes cold congestion is the first result. That is, the smallest blood vessels, the capillaries in the mucous membrane, become dilated. There is an unnatural dryness and a feeling of heat. About this time the victim begins to sneeze, because the nerves of sensation are being squeezed. Sneezing is an involuntary expulsive effort, just like coughing, intended to free the air passages of a foreign substance. But when the nerves of sensation are pinched they cannot tell the difference.

The same lack of discrimination is shown by the nerves of the eye. Weeping, except from emotion, is merely a flooding for the purpose of washing out irritating matter. And yet when the mucous membrane lining the eyeball or the lids is congested we cry. As a cold so often affects the eyes as well as the nose, the sufferer will soon begin to weep as well as to blow.

Usually the dry stage does not last very long.

Through the capillary walls exude the serum, or watery part of the blood, and white corpuscles, or lymphocytes. This discharge is often acrid and irritating, reddening the nostrils as well as the upper lip. But why enter into harrowing details? Everyone who reads this will become reminiscent and supply the sensations to suit himself.

The nasal passages being naturally narrow and confined—more so in some people than in others—the swollen membranes more or less occlude them if the congestion is great. And this occlusion is completed by the secretions, which become thicker as the cold ripens.

The victim by this time has lost his sense of taste, because he has lost his power to smell. And he probably has a frontal headache, because there are two accessory chambers or sinuses in his forehead which are connected with the nose. The lining of these chambers is likely to become much thickened and to press, one surface upon the other, causing great discomfort.

Also the process may extend in other directions. It may affect the middle ears through the Eustachian tubes, which connect them with the throat. Or it may go down into the larynx and bronchial tubes. In this direction there is no limit until it reaches the air cells of the lungs.

But this hypothetical cold affects, we'll say, only the hypothetical eyes and nose. Just an ordinary cold, without extraordinarily vicious tendencies. Gradually, if let alone—that is, if nothing is done to aggravate it—the symptoms will subside, the nose resume business, and the temper diminish in violence.

Before inquiring into the causes of colds and what may be done to prevent them it might be well to start

right by puncturing a few popular delusions concerning causes.

"Be careful not to get wet!" How often that has been said by solicitious wives and mothers. Clouds and rain and fog have little to do with it; or those who live among the clouds, in mountain observatories, would not be almost entirely free from colds.

"Don't get chilled!" One could nearly freeze to death a hundred times and not get a cold. Arctic explorers never do—until they come home.

Exposure to sudden changes of weather has no effect in itself. Those who live outdoors and are subject to rapid changes of temperature and humidity almost never catch cold.

Patients in tuberculosis sanitaria rarely do. But damp houses predispose to colds.

"Getting overheated opens the pores. Don't go outdoors with your pores open!" If one's pores were not open—wide open—one would not live long. The more they are clogged the more likely one is to take cold, and other things.

The truth is that heat, moist or dry, causes hyperæmia—that is, more blood in the capillaries of the surface of the body. This causes the sweat glands to work extra time, and the consequent sweat pours out of the pores. From perspiration—the invisible, intangible breathing through of the moisture—it becomes fluid, or sweat. A sudden chilling, especially if prolonged, will drive the blood inward and it may congest elsewhere.

And now for the conditions which actually cause colds. First, there are germs. Many are so imbued with the idea of the germ theory that they forget that it takes two to make a bargain. Most germs, all but

the most virulent, cannot harm us unless conditions are just right. And for conditions to be right for germs, they must be wrong for us. They require contributory negligence on our part.

Many germs have their habitat in the nose and throat. All of them have long names, but we shall mention only two kinds, the *Micrococcus Catarrhalis* and the *Diplococcus Coryzæ*. There are many other varieties, but they need not concern us here. No matter which particular germ or combination of germs, the symptoms are the same, and the inflammatory changes; and their presence accounts for the infectious character of colds.

If one member of a family has a cold the others may be affected subsequently. This is partly at least because the germs are present in great numbers in an active cold. But it may be due also to other conditions in the home, such as dampness, or overheating, or lack of fresh air, to which all the family are subject. But the germs are the irritating cause.

Speaking generically then, and not of any particular germ, the germs have been circulating, now in the microcosmic dust of the atmosphere, then entering a human nose with the respired air. Anon, overcome by the inhospitable host, gently waved back and coughed or sneezed into the circumambient air, they float in the impalpable dust again, suspended 'twixt heaven and earth, like Mohammed's coffin.

One day in this constantly repeated cycle their host is more hospitable. Conditions are not so unfavorable for them and they begin at once to raise the myriads of their kind. Being minute vegetables they multiply by segmentation, flourishing in the favorable soil.

Then follow the numerous conditions within that

nose and throat; and to the eyes, the ears, and perhaps the accessory sinuses, which as a group we call a cold.

In the beginning of this article the statement was made that one cannot catch a cold if he tries. That is nearly if not quite true. However, if anyone doubts it he may be able to prove his point if he tries any combination of the following directions for catching cold.

They are meant only for those who have good practical noses through which they ordinarily breathe. Of course one who has anything wrong with his nose to start with, such as obstructions or chronic catarrh or sinus disease, has an advantage. He is likely to catch cold on the slightest provocation.

First, choose as a habitation a house that is continuously damp. If that is impracticable work every day in such a building. Keep all the windows shut, especially at night. Remember that night air is bad for one, and as night air is the only kind one can get at night, keep it out. Use the good day air, or, better, day before yesterday's air.

Breathe in lots of dust. Have the floors swept vigorously and often while you are present. Do not use a vacuum cleaner or any moist method of removing dust. Chase it as you would pigeons, which rise and circle, and light again.

Keep the house hot; plenty of good dry heat. And wear heavy underclothing, which, unlike outer garments, cannot be removed when you get indoors.

Do not bathe frequently; keep the mouths of the pores clogged with unremoved waste material.

Eat more than you need. If your appetite fails don't weaken. Try rich sauces and pastries and condiments. And if necessary, or possible these days, take a cocktail or two to stimulate the appetite.

Lose plenty of sleep. Worry will help also; and fatigue, and overwork. Try to do all the unnecessary thinks you can think of. That may cause mental depression.

Having followed all or part of these directions conscientiously for some time, get your feet soaking wet and do not remove your shoes. Then sit next to the only open window. But open it only a very little, so that there will be a nice strong draft of cold air, preferably on the back of your neck.

You will probably win. In a few minutes or hours you may have a nice cold in the head with all the trimmings.

Sitting in a draft does not always give one a cold by any means, but it may, if one is in the proper condition.

Why are not sudden and extreme changes of temperature necessarily harmful? Because the human body possesses the most wonderful automatic heating apparatus in the world. Men have tried to imitate it in the modern dwelling, but they never have approached and never will approach its perfection. No matter how cold the weather, no matter how great the heat, in which one can live, this self-acting apparatus self-acts, and the bodily temperature does not appreciably change. Cold will chill the surface by contracting the capillaries of the skin, but very soon they will dilate and the surface will be warmed by the increased supply of blood. Heat will cause greater activity of the sweat glands, and evaporating sweat will cool the body.

How then do we circumvent Nature when we sit in a draft? A part of the body, usually a small part, is chilled while the other is not. We give the heating

apparatus an almost impossible task—that of keeping a large section of the body under normal conditions and at the same time protecting a small surface against the cold. Even its marvelous mechanism sometimes fails in such circumstances.

But these conditions do not alone produce a cold. There must be something else, a certain lowering of resisting power. Not long ago two people sat and watched a football game through an hour and a half of cold pouring rain. They were soaked to the skin. The next day one of the two had a cold, and of course it was an interesting topic of discussion.

That one said: "You can't tell be that getting wet dod't give you a cold. I certaidly got bide at the gabe!"

The other replied tolerantly: "Yes, my dear, but why didn't I catch cold?"

There you are! There is no argument. Many thousands were soaked and chilled that same afternoon, and it is hardly likely that ten per cent caught cold. First, there are the germs, then the exciting cause, and third the lowered resistance.

Constant conflict with bacteria develops an immunity in the individual. This immunity must be destroyed if the germs are to be victorious, unless they overwhelm their victim by force of numbers. This latter is sometimes the case when one comes in hourly contact with them at home, and partly explains the spread of an infectious cold among various members of a family.

If fighting germs increases immunity, so continuous absence from contact with them lessens it. Explorers returning to civilization after prolonged absence are more susceptible than those who have remained at home. Among those who dwell in isolated places an

infectious disease introduced from without will spread quickly.

All this is very well and may be of passing interest, but what we want to know is—and this is the meat of this cocoanut: How can colds be prevented? A large part of the answer is contained in the directions for catching a cold, if they are read with reverse English.

If the nose is not normal it should be put into proper condition. Obstructions should be removed. Operations for removal of obstructions are usually quite simple. Perhaps, when you were young, a playful tap on the nose by a companion threw it off center, and it never returned. Possibly when too young to recognize the proprieties you were given to sucking your thumb and pressing at the same time with the forefinger of the hand upon that tender nascent organ, the nose, causing a permanent deviation. In other words, the septum, or partition between the nostrils, may lean too much toward one side, obstructing the passage of air. There are many other causes of obstruction than a deviated septum, but this will do as an example.

Chronic catarrhal conditions predispose to colds, and to many other things. Germ growth is favored by poor soil and chronic inflammation makes poor soil.

But given a perfectly good practical nose, how can one keep it, and himself, from the incidence of such accidents as colds?

Fresh air, for one thing. As was said before, patients in tuberculosis sanatoria, who are outdoors practically all the time, are seldom affected. And if the attending physician comes upon one with a cold he says to the patient, "Ah! You've not been getting enough fresh air!" and at once consigns him to a bed in the open.

Open-air games are more healthful than indoor sports or exercise. If one must exercise indoors all the windows should be wide open.

Many use the calendar instead of the thermometer as a guide to clothing. It is as senseless as discarding one's straw hat on September fifteenth, no matter how hot the weather; and far more harmful. Both in the fall and in the spring we wear too much on the warm days, and stew and fret and catch cold without realizing why.

Most of our warm clothing should be removable—that is, removable in the presence of company. Homes and offices and factories are usually up to summer heat in the coldest weather, and yet many people who spend nearly all of the twenty-four hours indoors wear heavy winter underclothing. This superheating of the body lessens the resisting power. Remember, it does not open the pores. One should do that daily by a good bath with soap and warm water, and follow it with a dash of cold water.

The ordinary tubbing which is supposed to be a daily rite of our English cousins is much advocated as a means of hardening oneself. It usually consists of a dash into a tub of ice-cold water, a dash for the towel, and a dash into one's clothes. It is not cleansing and will not open the pores. Take the cold water for dessert, using soap and water as the pièce de résistance.

And do not rub all the outer layers of the skin off with brushes, "loofas" and extraordinarily coarse towels. In some countries they wear those outer layers of the skin for clothes, and they do not catch cold. Nature intended that the outmost layer, only, should be rubbed off by gentle friction.

It may not be necessary, now, to mention alcoholic

beverages. But if any one should have a little left over in this period of drought, here is a recipe for taking a cocktail: Spill a little on the tablecloth or doily, then glance around to see that no one is looking, and throw the rest over the left shoulder, for luck.

Remedies are of some use, but they should be prescribed by a physician for the particular cold they are intended to banish. As a rule, however, modern medicine has little to offer, and with two exceptions the granny remedies are best. The first exception is the hoary axiom: "Feed a cold and starve a fever." A cold is not, dietetically speaking, voracious. Feed it very little and it will be much kinder to you. And take a laxative, or two, as atonement for past indiscretions.

The other exception is the hot stuffy room as a means to a cure. Plenty of warm bed clothing, the body entirely immersed in coverings if thought necessary, head and all—all except the nose. Keep it out and take in through it all the outdoors you can get. Fresh air is the one essential medicine.

Having eliminated these two exceptions, bring on your granny remedies—the hot milk or hot lemonade; the hot salt gargles or spray; the quinine, if you like it; and the hot mustard footbath. All of these are a kind of bloodletting. They dilate the capillaries at the extremities and upon the surface of the body elsewhere, and they cause sweating, which is another form of relief.

By dilatation of the myriads of capillaries in the skin they draw away the blood from the congested area in the nose and throat, thereby lessening the inflammatory process.

One who has a severe cold should be put to bed—for

his own good and that of others. Colds are catching if one's condition invites them.

Applications to the nose and throat are helpful if made by one who knows what is needed and how to apply it. If there are complications—that is, if the ears or sinuses are affected—competent advice should be sought to prevent serious trouble.

But whatever you do for a cold do not take promiscuous advice. Do not follow all the precepts of kind friends. Or you may never have another cold.

TWO

CONCERNING COUGHS AND COUGHERS

COUGHS should be an interesting topic because so many people are subject to them, especially during the winter months. And yet a cough is not a condition, it is merely indicative of a condition; in fact it may be indicative of many and diverse conditions, among which may be mentioned: Colds, influenza, cigarettes, peanuts, pneumonia, shoe buttons, germs, tacks, mouth breathing, over-eating, safety pins and a weak heart. That will do for the present, but the list could be made much longer.

A cough is Nature's method of expelling something from the air passages that should not be there. But Nature cannot always discriminate between that which can be expelled and that which cannot, between a real object and merely a sensation. For this reason we cough when we have inhaled something irritating, and also when there is inflammation from disease.

Speaking of inhaling something irritating, no one would believe, unless he has looked into the matter, how many objects get into the air passages by mistake, objects not intended to be inhaled or even swallowed. Many persons—not all of them children by any means—use their mouths as temporary pockets for things not meant to be swallowed; and occasionally something slips down with a sudden inhalation. Then there is an explosive paroxysm of coughing, a surprised and indig-

nant attempt by Nature at forcible expulsion of the intruder. The effort is not always successful, however, and the object remains, to cause an infinite amount of trouble.

The discovery of the X-ray has helped to locate foreign bodies in the air passages, because mostly they cast a denser shadow than the surrounding tissues, but until very recently their removal required long, tedious and dangerous operations. Lately an instrument has been devised for looking directly down the throat. It is called the bronchoscope. It is a straight tube with an electric light at one end, and one has to do a sword-swallowing feat to get it down, but with considerable dexterity on the part of the operator and a throat rendered insensitive by a local anesthetic it can be done. There are medical men whose specialty is to locate and remove foreign bodies that have been inhaled.

A curious fact has recently been discovered: It is that the innocent, common garden variety of peanut—not one with the shell on but the smooth kernel—causes more trouble, greater destruction than a bean or a screw or a pipe stem. But they are all destructive and none was intended to enter the breathing apparatus.

This article, however, is not especially concerned with extraordinary and unusual coughs. It will deal rather with the more frequent and ordinary causes of coughs, and how to avoid them. But first something should be said about the breathing apparatus, its mechanism and its function.

You may remember the time when you stood by a bowl of goldfish and watched them swallowing. Perhaps you were fascinated and wondered how soon they were going to burst with high water pressure from

within, and possibly you may recall that you were relieved—or disappointed—when you learned that they were not swallowing the water at all but passing it out at once over their gills. And later still you were told that they were not breathing the water but the air which is held in solution in the water.

A fish uses air very much as we do, but it must have the air mixed with water. The gills are the fishes' lungs. They are crowded with minute blood vessels and when the air in solution passes over them it is extracted. After you had learned all this—which is really more marvelous than what you thought was going on—you probably lost some of your interest in goldfish.

Before a child is born it breathes like a fish—that is, it gets its oxygen from the stream of the mother's blood, through an apparatus very similar to gills. The child's lungs are not yet in use; they are totally empty and collapsed. But with the first gasping cry they are expanded, and from that moment they are never entirely empty of air. The tide of air alternately rising and falling leaves always a residual reservoir.

The lungs are a chemical laboratory, extracting oxygen, transferring it to the blood through the capillaries which line the walls of the air cells, and taking in exchange the products of combustion, which are cast off in each succeeding exhalation. And if the inhalations and exhalations did not succeed each other with considerable regularity, at the average rate of about eighteen times a minute, or twenty-six thousand times a day, or five-sixths of a billion times in the three-score years and ten, the owner of the lungs would depart before his allotted time.

So it behooves us who are the beneficiaries of this

important breathing apparatus to know something about it and what may be done to keep it fit for its duties.

Imagine a hollow tree upside down, its bulbous hollow roots at the top, then the trunk, then two large limbs. Farther down, smaller and smaller branches, the minutest twigs ending in groups of hollow leaves. Bind this tree's branches and leaves together with a soft, delicate, elastic, but firm substance that holds all the parts together as a whole. Throw over it all a covering of smooth satiny texture. Then place it in a box lined on all sides with the same covering. The box must have sides and bottom that are movable, to give it the power of expansion and contraction. As our tree is hollow and as the roots have openings, expansion of the box will cause air to rush into this tree, through the trunk, thence through the smallest branches, into the groups of hollow leaves; and contraction will expel a part of the air, not all but a large part, to be replaced again by more air with the succeeding expansion.

It is really not a far-fetched simile to liken the lungs to a hollow tree. If it were possible to get a mold of the breathing apparatus which would include everything from the nose and mouth to the remotest air cells, the resemblance to a small tree would be remarkable. But as this cannot be done because of the extreme minuteness and delicacy of the terminal structures, we shall have to stimulate our imagination by further description.

First, the roots of our tree: Let them be the mouth and nose, because they are directly connected with the tree trunk. But just below the back of the mouth two tubes lead downward, one collapsible and the other always standing open. The latter is the trunk of our

air tree. Down through the collapsible tube pass solids and liquids, into the stomach. But once in a while when eating, and always when we least expect it, we choke and cough and strangle. After the explosion is over somebody may say something about Sunday throat. The Sunday throat was not intended for the passage of food or drink; its function is to receive air only—on Sundays as well as on weekdays.

For the purpose of guiding food in the way it should go, at this parting of the ways is placed a valvelike covering which fits down over the air tube when one swallows, but at all other times is lifted. Sometimes we are careless and breathe when we should swallow. Then the valve, the epiglottis, does not cover the opening and the particle of solid or liquid goes the wrong way.

Just below this opening, at the inverted base of the trunk, is the voice box, or larynx, a projecting part of which, the Adam's apple, can be seen rising and falling when one swallows. Across the middle of the open space in the larynx stretch two bands which are wide apart except when one wishes to produce sound. Then they become tense and their edges come together to make a slit of varying width, through which the air rushes, causing them to vibrate, to produce sound.

The trunk proper of our tree begins at the lower margin of the larynx. It passes on down about four and one-half inches before dividing into the two main branches, or bronchi, one of which leads to the right lung and the other to the left. Each bronchus begins to branch after entering the lung, and the branches subdivide, until finally the smallest tubes are not more than one-fiftieth of an inch in diameter. Then they lose their cylindrical shape and branch off as irregular

channels among the groups of air cells. These air cells, like the gills of the fish, contain the small vessels through which courses the blood that has come from all parts of the body, bearing the products of combustion to exchange for oxygen, with which it returns to the tissues, to carry on more combustion.

The whole of the air apparatus, from the throat to the remotest air tubes, is supplied with nerves of sensation. This is unlike the heart, which being entirely inclosed and protected has no sensation at all. But Nature very prudently provides the lungs and tubes with sensation to enable one to cough, in the effort to expel whatever is injurious, whether it comes from without or is manufactured as a product of disease.

And very wisely too she places more nerves of sensation in the upper air passages, which are nearer the source of external dangers. For this reason, and because the nerves cannot judge between a foreign body and the irritation produced by swollen tissues, inflammation of the throat causes more continuous and more violent coughing than many more serious conditions in the lungs themselves.

The most frequent abnormal condition of the upper air passages is a cold, which may or may not have started in the head and gone down. In susceptible people, however, the congestion may begin in the trachea or the bronchi. This is especially the case with those who have obstructions in the nose, with those who are frequently in a very dusty atmosphere, and those who inhale much smoke. The last does not set apart cigarette smokers, because inhalation of any kind of smoke will do it; they are in a class by themselves only because they are more frequent inhalers of smoke.

In order to have a cold in the throat or chest two

conditions must always be present. They are: First, bacteria; second, a lessened resisting power. Indeed the same causes are essential to the acquiring of almost any acute disease anywhere in the body.

Nature has placed in the air passages every possible safeguard against disease germs. The nose filters them and its mucous membrane not only renders them harmless but the cilia, or hairlike projections on the surface, constantly wave them out by the way they came in. And the secretions of mucus catch them and they are washed away. But no one breathes entirely through his nose and some of the germs get farther down. There the same processes are carried on, because the lining membrane is of the same kind. This membrane has four duties to perform: It covers itself with a secretion for its own protection against cold air; it helps to warm the air before it gets to the delicate air cells; it gathers up bacteria and impurities; it destroys bacteria. So under ordinary conditions we are fairly free from harm. But suppose the conditions are not ordinary, and that a cold has already begun in the head. Perhaps it has been ignored and neglected. It goes down—that is, by extension it affects the throat, the larynx, and then the trunk of the breathing apparatus, the trachea.

First there is congestion of the small blood vessels, a dryness and heat of the surface, with hoarseness and a dry cough. Very soon the surface becomes moist and the cough loose. The oversecretion of mucus, which is Nature's attempt at self-cleansing, is coughed up and expelled.

Nature never gives up a fight unless the odds are overwhelmingly against her. Conflict arouses her antagonism and all her fighting forces are called into

action. If they were not, even the germs which most frequently cause catarrhal colds would be victorious, and they are not especially virulent.

But from the beginning of the attack there have been disagreeable sensations. There was probably a chill and now there is some fever, also aching and soreness of the muscles and a general tired feeling. All of these are due directly to the germs against which the body is fighting. They produce certain poisons which are absorbed into the blood, causing much disturbance and discomfort.

However, washing out the germs by an excessive secretion of mucus and a cough is merely a defensive process. Nature has offensive forces also. With the first congestion the blood streams have brought up the army of white corpuscles. These troops hastily mobilized storm enemy trench after enemy trench until finally they have regained all the home territory. And the casualties are thrown out with the expectoration. Then the home troops withdraw into the blood streams, which once more resume their normal size, repairs to the battlefield are under way and peace supervenes. Peace, not armistice, for there can be no cessation of hostilities until Victory alights upon one banner or the other. There are no drawn battles in the fight against disease.

But at times the issue may be long drawn out. It may be that the particular strain of germs is more virulent and that its invasion finds the defenses weakened. Then the destructive warfare continues and more territory is invaded. By this extension the inflammation may progress downward, through the smaller bronchi—the branchlets of the respiratory tree—until it reaches the terminal leaves, the air cells.

When this occurs the sufferer no longer has bronchitis only; he has broncho-pneumonia, a much more serious disease, to which the very young and the aged are more prone than those of middle years.

Most of the germs that ordinarily obtain entrance into the respiratory tract have no harmful effect unless its lining surface has been injured. The same is true of the skin. The hands come into daily contact with hosts of bacteria, especially the pus germs; but the outer layers of the skin are protective. If, however, the skin is broken or the tissues bruised the germs set up their destructive processes.

Within the air passages a sudden chilling of the surface, by breathing intensely cold air, and the reactionary congestion, will destroy the integrity of the lining. But the most frequent cause is dust. Irritating particles inhaled have an erosive effect upon the membranes. Then the germs enter through the broken surface.

Living in a dusty atmosphere will cause chronic bronchitis. The membranes become thickened and there is a more or less constant secretion of mucus, with a chronic cough. This thickening of the lining, when it reaches the smallest tubes, makes respiration difficult.

But, curiously, outbreathing is impeded more than inbreathing, because expiration is ordinarily a passive act while inspiration is the result of muscular effort. The chest wall is raised by forcible muscular contraction, which causes the inrush of air, but when the chest muscles and the diaphragm relax the boundaries of the lungs come closer together, narrowing the space between. We can breathe out forcibly when we choose, but in unconscious respiration expiration is entirely passive.

When there is a chronic thickening of the lining of

tne small air tubes one can get air into the cells through the narrowed passages, but it is difficult to get it out again. And so taking in a little more air than can be gotten out easily the air cells become permanently dilated. This produces the barrel chest so common among coal miners and those who work in a dusty atmosphere. These persons have a chronic cough, a shallow sometimes gasping respiration, and a wheeze.

A cough may be useless and harmful or it may be beneficial. If there is a foreign substance in the air passages or an accumulation of secretion coughing is the only method of expulsion. The use of a sedative in such a case would be wrong. Taking medicines to deaden one's sensibility to the presence of anything that should be gotten rid of would defeat the purpose of the cough.

But frequently coughs are due merely to irritation of the nerve ends, caused by their being caught and pinched in congested swollen tissues. This kind of cough is rasping, exasperating and futile. It should be quieted because it accomplishes nothing.

Coughing will cause a cough. Persistent hacking will in itself produce congestion of the throat sufficient to continue the cough indefinitely. Here is an instance of a cough that was started by the imagination: A nervous, hysterical patient had been afflicted for years with imaginary ills. But her troubles, though various, had always been elsewhere than in the throat or lungs. One day her mother caught cold and developed a dry cough with hoarseness. The next day the girl was coughing continuously. Examination of the throat and chest discovered nothing wrong. She merely imagined it all. But with the persistence of the hysterical she kept up the coughing for days, and finally she lost her

voice completely, being unable to talk above a whisper. Later examinations disclosed a deeply congested throat with great redness and thickening of the vocal bands. She had kept at it until she had produced a real condition.

This is related to illustrate the kind of coughs that is harmful. Coughs that do not get anywhere should be suppressed, if possible, or soothed by medicines if they cannot be controlled. The purely nervous cough can be stopped by an effort of the will. But it would be folly to use opiates for a cough that gets results. In the later stages of pneumonia or of tuberculosis one who cannot cough is in a very serious condition. He is in imminent danger of drowning in his own secretions.

The causes of coughs being so numerous and so various, to speak of prevention one must necessarily include the conditions which produce them. First, then, the nose. To have a normal throat and healthy lungs there should be free, unobstructed nose breathing. Air which is taken in through the mouth is germ laden, dust laden; it may be too moist or too dry or too cold. The nose should cleanse it, warm it, moisten it; or the air passages will suffer.

Children with adenoids are especially subject to coughs because they cannot breathe through the nose. The adenoid child has a peculiar facial expression—a flattened, pinched appearance about the nose, which from lack of use is almost invariably smaller and narrower than it should be. And the adenoid child nearly always has large tonsils.

Mouth breathing leads to disease of the tonsils. They are placed in the throat partly as a filter for use in such emergencies as occasional mouth breathing. But to ignore the nose altogether and take in air con-

tinuously through the mouth is to place too much burden on the filters. They become diseased as a consequence, and in turn they are a cause of coughs.

Adenoids should be removed, and the channels through the nose otherwise made clear if there is any other obstruction. If this is done in time it is probable that the tonsils will be saved from chronic inflammation and from the necessity of removal.

There is a class of ailments called "occupational diseases," because they have their origin in certain occupations. Among these are the chronic bronchitis of coal miners and stonecutters' consumption. A curious fact has been noticed about coal miners, especially those who mine bituminous coal: They are easy victims of chronic bronchitis, of asthma and of emphysema, or permanent dilatation of the air cells; but they are comparatively free from tuberculosis of the lungs. No one has been able to explain this phenomenon satisfactorily, though several theories have been advanced. And yet physicians who practice in the bituminous-coal regions are convinced that there are fewer cases of consumption among the miners than among men in other occupations.

On the other hand stonecutters and men who work at emery wheels are particularly prone to tuberculosis. The irritating particles cut their way into the delicate structure of the lungs, making a fertile soil for the growth of the bacteria.

There are many other occupational consumptions also, as for instance that of those who work with cotton fiber, with tobacco and with flour—all of them dusty jobs. Which merely substantiates what has been said about dust being a potent cause of troubles in the

throat and lungs, and emphasizes the warning that it should be avoided as far as possible.

Colds are infectious, there is no doubt about it. No argument will be required here to prove it, because everyone has noticed that they spread from one to another in home or shop or office. A cold hits one in the weakest place. One who has a weak throat usually gets his cold there, either at first or very soon after it has begun in the nose. Now a weak throat is almost invariably the result of some long-continued indiscretion that can be avoided. The inveterate cigarette smoker is liable to coughs at all times, because he inhales the smoke, and to an acute inflammation of the throat with every cold. As to prevention in his case the answer is obvious. In the case of those who work at dangerous occupations—dangerous because of the peculiarly irritating quality of the dust created—the mouth and nose should be covered with a moistened cloth of fine mesh to strain the respired air.

But whether one has a susceptible throat or not, intimate contact with the victim of a cold should be avoided, because one may come in contact so continuously with the various bacteria by continuous association with the victim of a cold that their very numbers and assiduous attacks will overcome his resistance.

As with other infectious diseases, one's susceptibility to colds depends very much upon one's physical condition. The instructions given in the previous chapter on how to catch a cold and how to avoid it apply here as well as to cold in the head. In general they imply only good commonsense in the care of the body. A great deal of fresh air; enough rest and sleep; plenty of food, but not too much nor too rich food, eating only as much as is required by an appetite not stimulated by

alcohol or condiments; frequent bathing without excessive rubbing; warm water and soap, followed by enough cold water to cause a reactionary glow.

Sudden chilling of the body may or may not induce a cold, depending on one's general condition; a cold is especially likely to result if one has to remain long in wet clothes on a cold day.

A very cold dry wind will sometimes cause congestion, but this is usually only if one breathes through the mouth. Such a congestion is a reaction. The cold air causes the small blood vessels lining the throat and bronchial tubes to contract, and afterward they dilate. This is the same process that may be observed in the flushed face or the tingling reddened hands after exposure to cold.

Chronic coughs may be due to other causes than dust and mouth breathing. A weak heart will cause a sluggish blood current and the blood will stagnate in the lungs. Then there will be a constant soaking of the tissues. In chronic kidney disease frequently there is the same result. In such cases the avoidance or cure lies in correcting the primary troubles.

A chronic or frequently recurring cough should awaken the suspicion of tuberculosis. This disease, however, is often masked and there may be no cough or at least so little cough for a long time that though there may be great weakness and other profound symptoms the lungs may not be suspected. But where the cough is obstinate the lungs should be thoroughly examined.

Coughs that occur in the course of other diseases need attention, especially if they are of the dry, harassing kind, because they cause loss of sleep, mental

unrest and add to the general distress. Such coughs call for a sedative.

Except in acute inflammatory conditions much of our coughing is unnecessary and can be controlled. You don't believe it? Have you ever been at the theater watching a thrilling play? Have you sat, looking, listening, almost breathless in the tense palpitating silence? Have you seen the interest suddenly die, killed by the introduction of something incongruous or by one of the actors? Then have you heard the perfect storm of coughs rising from all parts of the house, coughs people had been saving while they were enthralled?

Yes, much of our coughing can be suppressed and should be, because coughing will aggravate a cough.

THREE

PNEUMONIA, THE APACHE

ALL acute infectious diseases are enemies of the human race. They may be likened to highwaymen, gunmen and other assassins. But pneumonia is the Apache, always lurking in dark places, waiting to pounce upon his victim, and with swift sure stroke to lay him low. There is nothing slow and insidious about pneumonia. One moment you are moving happily along, you turn a corner, there is a descent of the knife, and you have fallen. A sharp and bitter struggle follows. If you are strong enough to get the better of your assailant he suddenly gives up and makes away. The attack has been swift, the encounter fierce, and the departure equally abrupt.

There are several kinds of pneumonia, but the one whose name should be capitalized is Lobar Pneumonia, man's deadliest enemy among the acute infectious diseases. It is responsible for more deaths than any of the others, and it is taking more and more human toll each year.

Lobar pneumonia is so called because it usually begins in one lobe, the lower lobe of the right lung being a favorite site. And though it may confine itself to one lobe it often attacks other lobes, at times affecting both lungs. Then it becomes the dreaded double pneumonia.

By far the most frequent cause of pneumonia is an

exceedingly small germ called the pneumococcus—a deadly germ, but not always equally virulent, and with some persons apparently not virulent at all. Certain animals, especially the rabbit and the mouse, are much more susceptible than human beings; in fact though it is probably present in more than half the throats of those living in cities by no means all of this number get pneumonia. Those who carry about with them these bacteria, but who are not affected by them, are called "carriers." They can give the germs to others more susceptible and themselves remain immune.

Like other infectious diseases, pneumonia when introduced among a people to whom it has been a stranger creates great havoc. But those used to city life are to a certain extent protected. If all persons who become the temporary carriers of the pneumococcus were stricken with pneumonia the disease would become a scourge more dreaded than all the plagues of Pharaoh, because of its high death toll. About one-quarter of all those who have pneumonia succumb, so it is well for the continuance of the human race that of those who frequently harbor the germ in their throats not all are susceptible.

A standard medical work published a few years ago states that "The course and outcome of the disease are uninfluenced by ——" and then it names categorically practically almost every means which can be used in the treatment. And further: "At present the infection is beyond our control other than such simple measures as tend to spare and support the strength of the patient by careful nursing and the alleviation of symptoms. Useless medicines should be avoided."

That is, the medical profession is helpless to prevent or to cure. Make the victim comfortable, lessen his

pain and other distress. Watch him fight the powers of darkness alone and unaided—except by the forces within himself. They must carry on while the physician and friends stand by. The issue will depend entirely upon the relative strength and endurance of the opponents.

A black outlook, surely—or it would be if it were not modified by certain facts. The first fact is that the healthy person stands considerably less chance of getting pneumonia than one who is below par. It takes more than the germs to cause this disease. As with other diseases there must be contributing causes. And concerning most of these contributing causes, whether or not they shall be present to help the pneumococcus in his attack upon us we can decide and determine if we know what they are.

The second modifying fact has to do with quite recent discoveries in prevention, which were promoted by work in camps and hospitals during the war. The war brought together the most advanced, the most skilled specialists among the medical men of the country. It also brought together millions of young men. Many of the soldiers, removed from their accustomed environment, were taken ill with the various infectious diseases. They had every known disease and every variation of disease. Moreover, the sick were cared for in groups in the great hospitals where their afflictions could be studied. Also the scientists were there to study them.

Thus was pneumonia observed from every medical angle by the members of the hospital staffs and by commissions sent out by the Surgeon General to gather facts and to correlate them. And so was forged another weapon against the monster, not yet perfected,

but developed so that it has proved its beneficence in thousands of instances. Of this weapon more will be said in its proper place.

One who has had pneumonia will not need to be told how swiftly it attacks or what havoc it creates. But many have not had it, and for this reason it may be expedient to enter into a somewhat detailed description.

You may or may not have a cold. Probably you have not been feeling well for several days. Perhaps you have been losing sleep or overworking or attending too many formal dinners or have been committing any one or any number of the common physical indiscretions.

One day you go home feeling chilly and languid. During the next day or two these disagreeable sensations continue, but you are too busy to pay much attention to them. If you have been coughing for several days you attribute everything to the cold.

Then like the traditional thunderbolt out of a clear sky comes a chill. A real chill, not a chilliness, that makes you long for all the hot-water bottles in the world. And with it a pain. Not a stitch but a stab; a continued rhythmic stabbing with every catching breath. And a short sharp cough that adds to the torture, infinitely increasing the pain.

"Send for the doctor!"

He comes, and finds you with a high fever, though you may still be shaking with cold. He feels your pulse; it is racing. You are breathing rapidly, much more rapidly than your fever warrants, because your respirations are shallow, caught almost at the very beginning by the racking stabs in your side. He listens to your heart and to your breathing, but at this stage

of the disease they disclose little. However, he knows by inference. He is cheerful and attempts to reassure you, but downstairs he says: "Pneumonia!" You are in for it, and may you be one of the seventy-five per cent who recover!

What is taking place in your lungs? Something has been happening to you for several days before the attack, and you did not know it. In the first place, there were the germs. You may have harbored them in the throat and air passages for many days, but at least you had them for a time before you were stricken. Then came the exposure to cold and wet, resulting in a cold. Or, whatever it was, something occurred to break down your natural immunity, your usual resisting power.

This period between the true beginning and the violent onslaught is called the period of incubation. A better term would be the period of germination, because the seeds, the pneumococci, are plants, and they must reproduce millions of their kind before you are conscious of trouble. During this time, lasting from two to eight days, the symptoms are vague. You may feel merely out of sorts. But the poisons created by the bacteria are accumulating and are being absorbed into the circulation.

In the meantime, though you have been unaware of impending danger, your body knows. It has at once begun to fortify itself, to manufacture a tremendous number of the opposing forces against the invaders. In pneumonia as in other germ diseases it is the white corpuscles, certain kinds of them especially, that fight for us by destroying bacteria. So, long before your chill, before you are laid low, while the germs are increasing in number in your lungs, the white blood cor-

puscles are being manufactured in great numbers and are beginning the fight for supremacy.

One of the first things the doctor wants to know when he is called is the amount of your leucocytosis. Leucocyte is the proper name of the white blood corpuscle. The number of these fighters may have increased from two to twenty times the number present in the blood in health. And if you have a large number of leucocytes your chances for recovery are better than if the number were small. But in spite of all this preparation the bacteria have gained headway, and in their growth, millions upon millions of them, they have created enough disturbance to produce pneumonia.

The chill, the headache, the muscle pains—all the distressing first symptoms are caused by the poisons that have been taken up by the blood and distributed throughout the body. In the lung, at the site of their invasion, there is congestion. This resembles the congestion of ordinary diseased conditions as a cloudburst resembles a shower. It is overwhelming. All the blood vessels are swollen and engorged, and they will soon discharge certain elements into the groups of air cells. The inflammation is so violent that it nearly always affects the lining membrane of the lung, the pleura. Pleurisy, or better, pleuritis, causes the catching pain which occurs with every breath.

Then comes the exudate, a sticky discharge that soon will fill all the air cells and shut off entirely the breathing space of that lobe, throwing all the burden of respiration upon the unaffected parts. The more lung shut off from air the greater the task for the rest of the lungs. The breathing is now rapid partly because of this decrease of air space.

But the blood has not only absorbed poisons; the

germs themselves are invading the blood stream. Through it they may reach other organs and tissues of the body—the heart, the joints, the brain. Even the middle ear may be affected. Purulent inflammation of the middle ear is a frequent complication.

The heart has a tremendous burden thrust upon it. By the force of its contractions it must send the blood stream to every part of the body with sufficient velocity to insure a constant circulation of the stream. If there is an obstruction anywhere the work of the heart is tremendously increased. And here is a large area in which there is obstruction because of the pressure of the exudate. Also the heart muscle may be affected by the poisons in the blood. And the heart must beat faster because of the high fever. The great majority of fatal cases are directly due to failure of the heart.

During the progress of a pneumonia the doctor is chiefly interested in six things: First, the amount of lung involved, whether there are any fresh invasions. Second, the height of the fever; if the temperature remains very high the outlook is grave. Third, the condition of the heart muscle, as indicated by the sounds which he hears through his stethoscope, by the rapidity of the contractions and by the blood pressure. Fourth, the leucocyte count; he wants to know how the numbers of the defensive army are being kept up. Fifth, what the other organs of the body, chiefly the kidneys, are doing to eliminate the poisons. Sixth, whether there are any complications, especially of the brain, as evidenced by delirium.

But let us say you are one of the seventy-five who recover, of every hundred persons attacked. One day —it may be the third, the fifth, the tenth, any day; there is a common but erroneous belief that pneumonia

prefers an odd-numbered day to stop—one day there comes a change. This change is usually as sudden and wonderful as the appearance of the sun after a hurricane. It is a real crisis. There is a peaceful calm, the world looks as different to you as you appear different to those about you.

The wreckage remains; you are terribly weak, the struggle has left but a shadow of your former self. But that shadow will soon take on substance. Convalescence may not be rapid, but it will be an unspeakable joy. Let your joy, however, take the form of passive contentment. If your doctor detects any signs of bodily activity he will caution you: "A pneumonia patient is never out of danger until he is entirely well." The heart muscle must recover its strength before one can undertake the slightest exertion without risk.

It is entirely probable that, as you lie there, dreadfully weak but with a clear mind, you cannot remember much about your illness. It is as though your body had lain ill and your mind had been elsewhere. Those who watched anxiously your struggle will recall all the details, especially the grave assiduous attentions of your doctor and nurse. They remember some of the doctor's dircetions as to your care.

"All the windows up!" he had said. "As much fresh air as he can get. Remember, a part of his lungs is out of commission and the rest has to do the work. He needs all the oxygen he can get."

"But the weather is cold. He will freeze!"

"Never fear; have a fire to make the air circulate more freely, but cold fresh air cannot hurt him. Cold water is used to bring down a high temperature. Why is not cold air just as good?"

And when friends called they were barred from the

sick room for fear their presence would excite you. Also, you were not allowed to move in bed without being helped, to avoid unnecessary strain upon your heart. And you were sponged frequently, at regular intervals, to keep your skin active. To assist your kidneys in carrying off the poison you had to drink more liquids, especially water, than you thought necessary. Your sputum was carefully kept and burned, that it might not infect others. And the attendants washed their hands frequently, that they might not convey the infection to their lips. And you were constantly watched, day and night, for fear that in sudden delirium you might attempt to get up or otherwise do yourself an injury.

And so, finally, partly because of these attentions, partly because of certain medicines which were given for particular conditions such as pain and annoying cough and sleeplessness when you were so restless, but mostly because you had the elements of fight within you, you triumphed over the arch enemy, and he suddenly fled. It was a glorious victory.

But it is probable that under certain conditions the victory might have been yours in the first place. You might have conquered the germs before they germinated to cause pneumonia. To say that the pneumococcus is no respecter of persons is an exaggeration. It is no respecter of those who have lost their normal resistance to it. Everyone who is stricken has had the germs within him many times before and has not succumbed. But this one time he has lost something that he once possessed and which he might have retained.

This brings us to prevention. The first thing to avoid is a multitude of the germs or rapidly repeated infections. Unnecessary contact with those who have

pneumonia should be shunned. If one's duties are in the sick room care should be taken to cleanse the hands thoroughly, especially before eating. The sputum should be collected and burned frequently. All vessels with which the patient comes in contact must be washed thoroughly, disinfected, and kept solely for his use. Bedclothing and his personal clothing must be boiled.

But there are carriers who are not sick and who do not suspect that they harbor the germs. Such persons are a constant menace to others. The danger would be greatly decreased if everyone who has a cold were to cover his mouth and nose when he must cough and sneeze, especially in public places where the germs may be widely disseminated.

These precautions will lessen the danger of infection, but they will not remove it entirely. The other element of prevention has to do with the recipient of the germs, the fostering of his natural resisting power. The rules of conduct for the prevention of pneumonia are exactly the same as those for the avoidance of other germ diseases. The pneumococcus is more virulent than most of the other bacteria, but his method in attack is the same. And because of this similarity there must be a certain repetition of what has been enjoined with reference to colds and coughs.

Granting, then, that one is likely to come into contact with this desperate enemy at any time and at frequent times, what may be done to render him harmless? First, we must remember that bacteria cannot harm unless they penetrate the surface. This is just as true of the mucous membrane lining the air passages as it is of the skin. Something must mar that surface if they are to find entrance and a temporary habitat.

This brings us first and foremost to dust as an irritant and to mouth breathing. If there remains any doubt as to the importance of dust as a cause of lung conditions and of nose breathing as a preventive let the following evidence from the London *Lancet* of June 12, 1919, be read dispassionately. It is a comparison of the relative frequency of lung diseases in miners and in mine horses:

"The horse breathes through his nose, which stops nearly all the dust. Investigations showed that there were no lung ailments among horses; they were hardly ever sick, and their average working life was thirteen years. The health of the animals was excellent, although lung diseases had been common in human beings. While experimentally the horse can be given pulmonary tuberculosis and develop copious disease, their freedom from the same in normal life is probably due to exclusive nasal breathing."

Whether one accepts this conclusion wholly or not it is at least worth while to remember dust as an important factor in the susceptibility to pneumonia. Breathe through the nose habitually if you can. If you cannot, have the obstructions removed, that it may be used as it was intended to be used.

If you have a cold, any inflammatory condition of the air passages, avoid indoor crowds. A catarrhal condition predisposes to pneumonia, and it is safe to say that in every crowd there are carriers of the germ, who may be as dangerous to you as a lunatic with a weapon.

Spring and fall are fruitful times for pneumonia, because of sudden changes in temperature and humidity. But at all seasons avoid undue exposure to wet

and cold. Congestion of the mucous membranes of the lungs gives the pneumococcus his chance.

Other directions are still more general. They may apply to the avoidance of most of the diseases that affect mankind. Avoidance of worry is one of them. Long-continued worry will reduce the bodily vigor. Overeating is a predisposing cause. The use of alcohol is another. The alcoholic will soon disappear from among us, but for a time he will not be quite so extinct as the dodo. He has far less chance than others against the onslaughts of the pneumococcus, and when he is stricken his doctor knows that his prospects for recovery are poor.

It is at least possible that more and more of us are succumbing each year to pneumonia because life is becoming increasingly difficult. We hurry too much, we worry too much, we play too little. Our lives are top-heavy and the equilibrium is unstable. This is obvious in theory, but we do not act upon it. Most of us get our fresh air through a distant narrowly opened window, our recreation at the movies, and our physical exercise in walking two blocks to the cars.

If you should chance to live in any one of our American cities in certain parts of which thieves and gunmen are wont to ply their trade, and were to ask advice concerning your personal safety, you would get it something after this manner: "Don't frequent places where you are likely to meet them."

"But," you might protest, "my business sometimes takes me to such neighborhoods."

"Very well, then; keep your eyes open. Don't let them get you unawares. And keep yourself physically fit. You will stand a better chance."

"Is there no weapon I can carry? "Have I no other defense?"

The fact is that there is no weapon that offers absolute security to the onslaught of pneumonia, although at one time vaccination was very highly endorsed. Vaccination is not a new thing. Jenner, in 1798, discovered smallpox vaccine and the pock-marked face has ceased to be a prevailing style of physiognomy. Typhoid vaccination practically eliminated that disease from the army. Vaccination has been successful in combating cholera and plague and dysentry. It is probable that pneumonia vaccination will be useful.

What is vaccination and what does it do? It is the introduction into or beneath the skin, and thence into the circulation, of dead germs which, if living, would produce disease. The presence of these germs sets up a local irritation and starts the defensive forces of Nature. At the place of the injection there is transient inflammation, but throughout the body there is a righteous indignation, an awakening of antagonistic forces. Certain substances are formed in the blood that will help the white blood corpuscles in their fight against active, living germs of the same kind as the dead ones that have been introduced.

For a longer or shorter time afterward these defensive products will continue to combat successfully the special kind of germ which they have been produced to fight. And so vaccination, for a time at least, immunizes, renders one less liable to successful invasion. But dead typhoid germs will not immunize against cholera, nor plague germs against typhoid, nor either of them against pneumonia. Whatever the defensive products are which have been manufactured in each

case, they are different and they protect only against that particular kind of germ.

Therein lies the difficulty with regard to pneumonia. There are several kinds of pneumococcus; in fact there are four types of which three are constant and the fourth because of many varieties, not yet classified.

For a time, during the war, scientists had high hopes that vaccination would solve the problem of prevention in pneumonia. Of the thousands of men vaccinated as a preventative measure, not more than half the number were stricken with the disease as compared with those who were unvaccinated. But, unfortunately, a subsequent study of these and other cases has shown many sources of error, so that physicians are not so positive at present concerning the value of pneumonia-vaccination. Still, it is believed that medical science is on the right track, and that eventually, probably very soon, this dreadful disease will be conquered.

At present, however, the incidence of pneumonia is gradually increasing in America. But if science shall advance in the future as it has in the recent past with regard to other diseases, probably at some not far distant day, one will find in medical text books the following:

"Lobar pneumonia. A disease of the lungs caused by the pneumococcus. Once quite prevalent, but now rare."

For science is moving with giant strides in the right direction—toward the goal of prevention.

FOUR

T. B., THE CRIMINAL

YOU probably know that "T. B." is short for Pulmonary Tuberculosis. Just as we often refer to certain persons by their initials, so doctors, nurses, and even many victims of the disease, call it T. B., and thus save both time and breath.

You may not be a T. B. yourself, nor have had a case in your family. But you can doubtless name a dozen households in your own acquaintance which have been visited by the scourge. If you have not had some anxious times about yourself, or about some member of your family, you are one among a thousand.

And yet, although we think and talk a great deal about T. B., most persons have vague and mistaken ideas about it. Even the medical profession has been learning new things about it—and very recently, too. They are things which everybody ought to know.

To begin with, here are a few facts which will probably surprise at least some of you:

Tuberculosis is the most prevalent disease in the world, but pulmonary tuberculosis is only one form of it. It may attack any tissue in the body, including the bones or joints, and the brain and spinal cord.

Even T. B., or the pulmonary form, is much more widespread than is commonly supposed. Many persons have it and do not know they are sick.

It is the most curable disease in the world. The

vast majority of those who have it recover. In nearly every community there are persons, oldest inhabitants, who will tell you, if you have time to listen, that forty years ago Doctor So-and-so told them they had consumption and were doomed to an early grave! The point of the anecdote is that Doctor So-and-so has died long since, while the oldest inhabitant is still living and triumphant. That is what appeals to the oldest inhabitant; but the real point is that in all probability Doctor So-and-so was entirely right and that the oldest inhabitant did have pulmonary tuberculosis and recovered.

T. B. is rarely acquired from others after childhood; and it is almost never inherited.

It is so frequently simulated by other diseases that there is often great difficulty in recognizing it. As it is not nearly so infectious as we once thought it, our attitude toward those who have it has been wrong. We need not fear them.

The one exception to this is that the person who has T. B. should be removed from contact with *children*.

You must remember that infants and children are susceptible to the infection because they have not yet developed what is called immunity, which means a fighting antagonism to it. Those of us who have survived beyond the period of adolescence have been triumphant in so many conflicts with the germ that we are, under normal conditions, immune. It is the children with whom we are the most concerned, children and young people.

These are a few of the facts which our experience with young men in the army helped to prove and to disseminate:

At one of the base hospitals there was a large ward given over to the treatment of chronic pulmonary diseases. Half of this ward was occupied by T. B.'s, and the other half by victims of other conditions of the lungs. On the T. B. side there was a young farmer from Ohio who had grown steadily worse for weeks. One day, when his vitality had reached its lowest ebb, the surgeon came to him with cheering news:

"I've decided that you haven't tuberculosis," he said, "and I'll have you moved over with the non-T. B.'s."

The boy's wan face was lit by the first ray of hope that had brightened it in weeks. He was moved, and at once began to improve. Hope had revived, and hope had tipped the scales in his favor. Eventually he was discharged to his home, with a reasonable chance of ultimate recovery.

This incident is not related to illustrate the influence of mind over matter, which within certain limitations is obvious. It is told to emphasize the fatalistic attitude so generally prevalent toward tuberculosis. And also it points out the difficulty, even to physicians, of distinguishing tuberculosis from certain other lung conditions.

T. B. is an ancient enemy, but it was not until 1882 that the tubercle bacillus was discovered. Now when a great criminal has been caught, the police and the public at once try to prove him guilty of more crimes than he could possibly have committed. It is so in the case of *The People vs. Tubercle Bacillus*. On some counts he is not guilty. But he will "get his" if he is convicted on the others. Let us consider a few facts in his favor:

First, then, Tubercle Bacillus is not guilty of causing all the lung conditions with which he is charged. The evidence is often only circumstantial. And, besides, we now know that many similar crimes were committed by another criminal, Streptococcus, one of the pus germs. He was especially active in the camps, causing great destruction.

Many severe cases of bronchitis, many pneumonias, many chronic lung conditions, were laid at his door, after prolonged and numerous investigations. His methods are so similar to those of Tubercle Bacillus that at times it was quite impossible to decide as to his guilt. This was because suspicion had so long pointed to T. B. as the guilty one. And it is just as true among civilians as it was among the soldiers, that many persons are called tuberculous who are victims of Streptococcus and other germs.

Second, it may be said in extenuation that Streptococcus often follows in the footsteps of Tubercle Bacillus. The victim of the latter becomes an easy prey to the former. Most of the advanced cases of T. B. die of the ravages of Streptococcus.

Third, Tubercle Bacillus is not guilty, except in the comparatively few cases, of infecting the adult from without. He enters the body during infancy, or early childhood; and he waits, often for many years, until disease, or dissipation, or overwork, gives him his opportunity.

Fourth, granting that Tubercle Bacillus is everywhere, that he is the universal criminal, it must be conceded that he is not the destructive agent we once thought him. If he were, not one living soul of us would be alive!

If all persons who had ever had tuberculosis in one

form or another had been excluded from our army, there would have been no army; or at least one so small as to be totally inadequate. Of more than three million drafted or enlisted men, there would have been left to fight probably not sixty thousand. In other words, scientists believe that fully eighty per cent of all adults have, or have had, tuberculosis in one form or another. Some go further and assert that *every* adult is tuberculous.

This is not a recent discovery. It has been known for many years. But never before had there been an opportunity to examine so many young and presumably healthy male adults. One of the surprises was the discovery of so many who showed scars of previous T. B. Even these men were not all excluded, for in many the tissue changes were too slight for rejection. A large proportion of these men had fought and conquered the disease, totally unaware that they had ever had it.

At least once a year the head of a business concern "takes stock." He wants to know the physical condition of his plant, how much it has deteriorated, what repairs or replacements are necessary. Once in a long while a few of us visit the doctor for the same purpose. But the vast majority of people, unless overtaken by some physical catastrophe, do not stop to "take stock."

And so it required the catastrophe of a war to bring the nation to stock-taking time. For more than a century we had been a going concern. Never until the war began was so thorough an inspection of the machinery.

If there was any one thing upon which we prided ourselves as Americans, it was upon the health and vigor of our young men. We had no knowledge upon

which to base our confidence, but we "knew" that they were the most vigorous and virile in the world. Because they were Americans, I suppose, No data were at hand. The nation had never taken stock of its young men—nor of its old men, nor of its children, nor of its women.

The draft boards, making a preliminary survey, received the first shock. Day after day came the men chosen by lot. They came by the thousands, by tens of thousands.

And day after day defectives were cast out. There came the lame and halt, the blind (for purpose of war), the toothless, the flat-footed, the too fat, the too lean. There were days when members of the draft boards wondered if there were any young men in the land fit to fight.

Of course the final result was the best army, physically, that had ever been assembled in the world. But there was another army—hundreds of thousands of men who, because of physical disqualifications, were compelled to do prosaic things, the menial things, the inglorious things.

And there was the vast multitude of the totally unfit. Of a little over three million young men examined for military service, about five hundred thousand were rejected as physically disqualified! More than sixteen per cent. These figures are not absolute, but they are eloquent enough.

At first, the requirements were quite strict, but soon they had to be relaxed. Take as an example, the teeth. There had to be at least four molars, two above and two below, and enough anchorage for dental work. But so many toothless men presented themselves that a change in the rule was absolutely necessary. There-

after, a man was accepted who had but two molars, if they met for business.

The world war had been in progress about two years when reports began to reach this country "through channels" of the great number of cases of T. B. in the Allied armies. France alone discharged more than 80,000 soldiers for this cause. Later it transpired that about 60,000 of these men did not have T. B. at all! Most of them had been victims of Old Man Strep, and a large proportion of them could have been saved to fight.

For this reason it was extremely necessary that all suspected lung conditions should be most carefully examined by not one but several competent experts.

The applicant for life insurance is examined by one, possible two, or, at most, three physicians. But the man who finally got into the army had been passed by fifteen or twenty. And if at any stage of the examinations there had been doubt as to his condition, he would have been sent to the base hospital, where other experts would have kept him under observation as long as necessary.

Properly to visualize the birth of a soldier from the embryonic stage of the drafted man, let us take a single day during the draft examinations and a single hero from among the crowd.

Very well then, William Leander Jones. In that previous incarnation, before the draft, Jones may have been a banker, a butcher, or a ribbon clerk. Now he is merely Citizen Jones, resembling all the others in the fact that he is a male and of draft age.

Having entered the barracks, he is stripped to his gooseflesh, for, like the portal of death, nothing of this world is carried beyond. Then he is branded with

a number. Not branded with a red-hot iron upon his quivering flesh, but with a pencil upon flesh which quivers rather from contact with chill air.

And so, clad in *cutis ansorinæ,* which is Latin for skin of the goose, he starts along the mystic maze of medical meandering. From station to station he goes, chest to back with the man in front, back to chest with the one behind. He is being coldly appraised: Head, Eyes, Ears, Teeth, Throat, Limbs, Lungs, Heart, to Feet. One by one the defectives drop out, and still the stream moves on, steadily, hour by hour.

But Jones does not consume an hour in the process. If they are having a good day, without hitches, in half an hour he is through. He has been stripped, branded, physically examined as he has never been physically examined before, finger-printed, vaccinated twice, measured for and fitted with army shoes, and uniformed. He has also received his army tag and number.

If Jones had shown the shadow of a suspicion of physical disqualification, he would have been held for observation. But in one particular he imitates Pippa, he passes. Within thirty minutes he has been bereft of everything but his birthmarks, and goes through the exit of the barracks, not Citizen William Leander Jones, but Private Jones, Number 1,400,863, or something else.

Now Jones's mother had, from infancy, considered him rather frail. He had always been carefully guarded from exposure or hardship. If in his present confusion he has a single clear thought, it probably takes the form of self-congratulation. He has "passed." He is sound.

But with regard to T. B., the examiners have not committed themselves on two points: First, that he never had the disease. Second, that he is now absolutely free from it. What they have said is that he has no scars, no structural changes in his lungs to disqualify him. And also that he is not suffering from *active* or *manifest tuberculosis*.

Manifest tuberculosis is the T. B. with which we are familiar. The germs which have been "lying low," perhaps for years, have become active and are playing havoc. Activation comes from within, not from without. We have the germs, the seeds, in our bodies always. Improper or insufficient food, dissipation, worry, overwork, wasting or acute diseases—these prepare the soil, and the seeds germinate.

The draft boards and the special examining boards in the camps rejected, on account of T. B., a total of a little over 95,000 men. Only about 5,000 men were returned from Europe for this cause, an insignificant number considering the size of our army. This brings the total up to 100,000. And this was manifest tuberculosis, mind you, or else disabilities due to changes in the lungs resulting from previous attacks of the disease.

Unquestionably, the greatest benefit derived from these examinations was to the men themselves. A large proportion of them learned for the first time their condition. And with this knowledge, upon their return to their homes they were enabled to take proper care of themselves. For you must remember that T. B. is a curable disease. And, besides, the knowledge which many of them gained in military hospitals has no doubt been disseminated in their various communities.

It may sound like a paradox, but, in the final analysis,

tuberculosis is not *cured* in the sanatorium. If the patient remains long enough he may have his disease *arrested;* but a cure is not arrived at within several years. An institution for the treatment of tuberculosis is largely a school where people go to learn, not the theory of a cure, but the practical application of it, how to live right. The treatment of tuberculosis is one of the simplest things in the world, and yet one of the most difficult.

There are really only four essentials. They are rest, fresh air, proper food, and contentment of mind. Not the least important is the last of these. It does not seem complicated, does it? And yet each one of these essentials is so complex that they cannot be learned by precept alone.

People so often think they are resting, for instance, when they sit down in a chair for a little while each day. If anything occurs to break their rest, they shorten the rest period, hoping to make it up at some future time. But they seldom do, and the rest period must be rigidly adhered to, even if it extends for weeks and months rather than hours. As long as there is fever, the rest should be continuous.

Another criterion by which to judge the amount of rest needed is fatigue. In health a man becomes fatigued after undue or long-continued exercise. A normal amount of rest restores him to vigor. But in a wasting disease like tuberculosis, a much greater amount of rest is needed, even after the slightest exertion. To some invalids, walking about the room, or sitting in the chair, or talking to friends, is over-exertion. Nothing should be done to create fatigue that may not easily be overcome by a reasonable amount of rest.

Nowadays, everyone knows about fresh air; but to many people it means a window raised an inch or two if the weather is cold. Or it means plenty of fresh air in the daytime, but a stuffy bedroom at night.

Fresh air, in the proper sense, signifies a house or a workshop wide open! It means living in the open just about twenty-four hours every day. You do not have to run after fresh air. All you have to do is to sit still and let it come to you. Many a misguided patient has run himself into an early grave seeking that which was all about him!

There is not room in this chapter to discuss the question of food in detail. Proper food means nourishing, not necessarily expensive food. It means food properly cooked, thoroughly chewed. The processes of digestion begin in the mouth, but most of us take food as we store our coal cellar for the winter.

One of the greatest fallacies with regard to food and the tuberculosis patient is a belief that he must be stuffed all the time. No amount of food should be eaten greater than that which can be easily taken care of and assimilated. You would better put it in your pocket than in your stomach, if it cannot be digested.

Contentment of mind is more easily advised than acquired. It must be achieved by almost superhuman exercise of patience, but especially by the pursuit of light, useful occupations, as soon as they are allowed. Where the tuberculous are concerned, the problem is largely mental, although the end to be achieved is physical. Mental unrest is as injurious in these cases as physical overexertion.

Of all curable diseases, pulmonary tuberculosis is the most tedious, the most discouraging. Even the slightest degree of activity requires many months to arrest,

and graver conditions proportionately longer. Rest, then, is absolutely essential to a cure.

While the disease is active, the patient must be inactive. And no half-way business about it either. Absolute rest. Now, given a man recently arrived at a sanatorium, contrast the enforced idleness of a hospital with the bustle and excitement from which he has recently been removed. Give him the prospect of six months, a year, perhaps longer, of this quiet life. He wants to get home. Tell him that if he wants to get well he must stay, whether he wishes to or not, and what happens to him? He blows up. Wouldn't you?

What is the answer? As soon as his condition will permit give him something to occupy his mind—to keep it from turning around and biting him as a tarantula is supposed under provocation to sting itself to death. And Occupational Therapy came into being. Not occupation that will in itself cure, but that will supply the healthy mind so essential to a healthy body.

It is said that a change of treatment of any kind will help the consumptive for a time. Take away one medicine and substitute another, even if it is Worcestershire sauce. The substitution must be accompanied by strong recommendation, however. Why does it help? Because *hope* is imbibed with it. And if hope helps, so does contentment. The man must have something to do, something else than himself to think about.

This applies with equal force to the home, to public and private sanatoria and to hospitals for tuberculosis ex-service men and women. How many consumptives at home, do you suppose, who, because their minds are turned inward and not outward, become discouraged and fly from one patent medicine to an-

other, or from one physician to another, in the hope that the doctor or the medicine may do something for them which they should be doing for themselves? Patent medicines beguile. Each new treatment fans the feeble spark of hope into a temporary flame, which soon dies out, leaving again the ashes of despair.

In a hospital in Canada there was, in 1918, a Scotch-Canadian soldier who had been invalided home because of tuberculosis. For more than six months he had been growing steadily worse, until he considered himself, and was considered by others, a hopelessly progressive case. One day he told his doctor that he had given up. But he said he had one great longing, one desire that he would like to have granted before the end. He wanted to go fishing! The doctor knew that he was taking a desperate chance, but being himself reasonably sure that the soldier was not going to live long, he had him carried to a little nearby mountain stream, where he could sit on the bank and cast his line. At once improvement began and, strange to say, continued to convalescence.

This is an extreme case. It is not intended to suggest that every T. B. sanatorium should be located near a trout stream, but as an illustration of the salutary effect of occupational therapy.

In that same Canadian hospital for tuberculous soldiers, until occupational therapy was inaugurated, men were mutinous, they deserted, went A. W. O. L.—"Absent Without Official Leave." After they were given something interesting to do, infractions of discipline were reduced almost to the vanishing point. And, what is more, the percentage of cures rose.

Specialists in T. B. differ as to the exact stage in the disease when the patient may safely be given some light

occupation of his choice but they are pretty thoroughly agreed that the time does come during the progress toward health. It need not necessarily be a useful occupation, but it must be *something* to direct the eyes of the mind outward.

If he can work at anything that will help him when he gets well, so much the better. It will give the spur to lazy, creeping time.

Does it help? Ask the fellow who has tried it. He will tell you that the lagging hours which stretched into weary days, and the days into endless months, gather to themselves fresh speed.

With regard to the treatment of tuberculosis, one of the most revolutionary lessons of the war was occupational therapy. So much emphasis hitherto had been laid upon the rest cure—rest of the body— that mental unrest had been totally ignored. Strange that we could have been so blind! A disease that requires months, often years, to cure, that consumes not only bodily vigor but vigor of mind and strength of will! A disease full of discouragements that eat the very heart of the moral fiber and cause the mind to fret and worry at the expense of the body!

For years we have treated our criminals with more consideration. During a part of each day prisoners now have a place in the sun, literally and figuratively. And all the years those afflicted with tuberculosis had to sit idly—waiting, waiting, for the healing balm that so often never came. More of these unfortunates have been killed by mental disquietude than by neglect. If we have learned this one lesson, and none other, then the war, with all its horrors and sacrifices, may have been worth while.

FIVE

THE GREATEST PUMP IN THE WORLD

WHAT would you say of a pump that kept on pumping, averaging at least seventy times per minute, every minute in the day, every day in the year for, say, sixty or seventy years without stopping for rest and repairs? A pretty good piece of machinery?

No, if you were speaking of any other machine than the heart you would say it could not be done! And yet we take the heart's marvelous work for granted, never even thinking of it unless something goes wrong.

If illness anywhere in the body causes a disturbance of the heart's action, we are apt to think we have heart disease, although the heart may be acting only in sympathy, and have nothing wrong with it at all.

After a day of hard work, possibly after dinner, when you are comfortably reading the evening paper, you are suddenly stricken with a pain in the left chest that causes you to gasp with agony. This pain may be boring or cutting in character. Perhaps you feel a sense of constriction in the chest. You place your hand over the heart and find it beating wildly, which increases your alarm. You manage to gasp to someone to send for the doctor, and you are not at all sure that you will live until he comes.

Finally, after what seems hours of agonized waiting, he enters with that jovial professional air of his, asks

other members of the family a few irrelevant questions and possibly makes some comment on the ball game, not realizing your imminent danger. In jerky sentences you tell him, after he finally gets down to it, that you have a pain in your heart, that you cannot get your breath, and that you are afraid each one will be your last.

Calmly (why do doctors take things so calmly?) he feels your pulse, bares your chest, listens a moment to your heart, and then begins boring with his forefinger at your back to the left of your spine. You manage to tell him that there is nothing wrong with your back; it is your heart.

Suddenly he touches a sore place and you jump. You did not know it was there. Then his forefinger follows between your ribs until it comes to the front of your chest, and you jump again.

He listens now more carefully to your heart and finally, when he is through, you ask him, "Is it serious, Doctor?" He smiles in that tolerant way that doctors have and tells you that you have intercostal neuralgia, and that your heart was beating wildly because you were alarmed.

Now, pain in the spinal nerves, following the course of the ribs around the chest, may come from a diseased heart, but more frequently the cause is elsewhere. And the pain is never in the heart at all, but in the chest wall. It is only because it happens to be in the region of the heart that it is ascribed to that organ.

Have you ever been wakened from sleep by "palpitation" or paroxysmal rapid beating of the heart? Have you ever felt an emphatic thump in your chest after a momentary pause in the heart beat? In such cases the

heart is the cause of the sensation, but the sensation does not necessarily indicate a disease of the heart.

Have you "poor circulation"? That is, do you suffer from coldness or perhaps from numbness of the extremities? Don't blame the heart. The origin is probably in the stomach or the abdomen.

Do you have dizzy spells? Here, too, the heart is nearly always innocent. You would better watch your eating and have a general house-cleaning, or reduce your tobacco allowance. Possibly you may need glasses, or your ears may be affected.

Sometimes when you are lying with your head on a hard pillow you are able to hear the beat of your pulse, and with each beat there is a swish or roughened sound. Do not get alarmed. You are constricting a small artery by the pressure of your head upon your ear, and you only hear the sound of the obstructed blood stream.

Perhaps you are getting short of breath, and notice quite suddenly that you are not able to do as much as you used to do without discomfort. If you are getting fat, remember that it requires more effort to take a heavier body around than a lighter one. Perhaps you have been indulging yourself, eating rich food, taking little exercise, and your muscles are getting flabby. Don't accuse the heart; it has enough to be responsible for.

What, then, are symptoms and sensations which indicate a weak or diseased heart? The sensations are very few, as a rule. Pain is quite infrequent, except in the condition called angina pectoris. There is no use trying to describe the pain of angina pectoris, because even the one who has suffered is unable to convey in words the full extent of his agony. The heart itself has

no nerves of sensation, and even the pain of angina pectoris, which is a heart condition, is due to irritation of other nerves that do not touch the heart at all.

Shortness of breath, however, if it is persistent, and especially if it is increased upon the slightest exertion, points suspiciously to the heart. A continuously rapid pulse is another sign, although not quite so definite. That obscure nervous condition which science still knows very little about, and which is called, for want of a better name, Hysteria, may be accompanied by an extremely rapid pulse. Diseases of certain ductless glands, as the thyroid (goiter) also produce a continuously rapid heart action. But if you cannot walk upstairs without a pounding in your chest and a feeling of suffocation, your heart needs looking after.

Swelling of the ankles is another indication, which, however, may come from dilated veins in the legs, causing stagnation of the blood returning from the extremities.

Some night when you are undressing for bed, you may notice that your legs above the tops of your shoes are swollen and shiny. You press the surface with your finger and find that the pressure makes an indentation, or pit. This kind of swelling is called œdema, and is produced by blood stagnation, which may be caused by a weakened heart muscle failing to drive the blood stream outward from the heart with sufficient force to insure its proper return. Or, as indicated above, the flow may be slowed by an obstruction in the veins, or by their dilatation, which technically is called *varicosis*.

It is almost impossible to describe the heart and the circulation of the blood without using the simile of a force pump. The heart *is* a force pump. In fact, it

is two force pumps working independently and yet in unison.

Each side of the heart has two chambers; a receiving chamber, called the auricle, and an expelling chamber, the ventricle. There is an opening between them, which is closed by valves when the heart contracts, in order that the blood may not flow back into the receiving chamber, but be driven out into the circulation. The openings through which the blood flows out of the heart are also protected by valves, which prevent the blood that has just been expelled from flowing back into the expelling chamber. These openings and valves have a great deal to do with some forms of heart disease.

The circulation of the blood through the vessels may be likened to an irrigation system; but in this case the fluid conveys not only water, but food, oxygen, and certain other elements.

Let us see what the blood contains, where it goes, what it does for us, and in what condition it returns to the heart. First, the blood from the lungs fills the left heart, which contracts, driving it onward. The stream contains, first, nourishment from the food we have eaten; second, certain little bodies, called red corpuscles, which carry oxygen from the lungs; third, it bears troops, our defensive army which lives in the stream and which helps to destroy the germs of disease. These soldiers of ours, the white corpuscles, called phagocytes, hasten in great numbers to any part of the body from which comes an alarm invasion. They fight our battles every moment that we live, whether we are awake or asleep. If it were not for them, disease would soon overcome us, and we should be annihilated.

Leading out from the heart there is the main artery,

called the aorta, from which smaller arteries branch. These divide and subdivide, becoming smaller and smaller, until finally they reach the capillaries, which pervade every tissue of the body and are so small that they get their name from the Latin word for a hair. It is through the capillary walls that the nourishment, the oxygen and also the defensive troops, get into the tissues.

When a candle burns, the oxygen of the air unites with carbon to make carbon dioxide. Exactly this change takes place when the oxygen in the blood comes in contact with waste matter in the body. As they move onward in the stream, the red corpuscles give up their oxygen and take up the carbonic acid gas.

The blood stream also takes up various products of waste, which it carries to certain organs, such as the kidneys and the lungs, to be eliminated.

Leaving the capillaries, the blood enters the smallest veins, which soon empty into larger ones, and these increase in size, diminishing in numbers, until finally two large veins return the blood to the right side of the heart, to be pumped again into the lungs. This, briefly, is the double cycle of the circulation.

But the heart cannot perform its daily task without a stimulus. There must be a pumper as well as a pump; and the pumper is the nervous system. Two great nerves supply the heart with its incentive to work. One is the accelerator nerve, which causes the heart contractions, and the other is the inhibitory nerve, which controls the heart beats, and without which the accelerator nerve would drive the heart too fast.

Ordinarily, the stimulus from these nerves is well balanced and the heart beats regularly and with suf-

ficient frequency. But if one of them overbalances the other, there will be either a slowing or an acceleration of the beat, depending upon which one of them predominates. These nerves have nothing whatever to do with sensation. No nerves of sensation enter the heart, but they do connect with the heart nerves at certain centers or substations.

These sensory nerves are distributed over the surface of the body, mostly to the chest wall and down the arms. Any trouble in the heart itself causes an irritation of the heart nerves; and the sensory nerves, in sympathy with those of the heart, become irritated. It is in this manner that heart disease, or any long-continued disturbance, may produce the sensation of pain in the chest wall, or down the arms.

The heart may be handled, it may be cut, it may receive almost any serious injury, without causing pain; because it requires long continued irritation of the heart nerves to produce a sympathetic reaction in the nerves of sensation. Harvey, who discovered the secret of the circulation early in the seventeenth century, described how he had handled the exposed heart of the son of Viscount Montgomery without causing the boy any distress whatever.

"Heart disease," then, may not be a disease of the heart at all. That is, you may have certain sensations which you wrongly attribute to a heart condition; or your heart may be acting queerly because it is merely sympathizing with other organs which are in trouble. These sympathetic troubles of the heart are called functional diseases, to distinguish them from real or organic heart diseases.

In organic heart disease the fault may lie in one of three directions: It may be the pump; it may be the

piping system; or it may be the pumper, the nerve supply.

With regard to the pump, there may be a disease of the heart muscle; of its inner lining, the endocardium; or of its outer lining, the pericardium.

The heart is subject to many infections from other parts of the body which reach it through the blood stream. If there is an accumulation of pus somewhere, as around the teeth, or in the appendix, or the tonsils, the blood takes up the germs which cause it, and they often find lodgment in the heart, producing an inflammatory disease of the heart lining and also of the muscle itself. Certain diseases, such as rheumatism, will also cause an inflammatory condition of the heart.

The damage done in such cases is usually to the openings through which the blood flows, or to their valves. Wherever there has been a deep-seated inflammatory condition, scar tissue always follows. If you burn your hand severely, the burn in healing contracts and makes a scar. It is this contraction of the inflamed tissues of the heart which usually does the damage, causing the valves to become too small to cover the openings; or the openings themselves too narrow, thus obstructing the flow of blood. Valvular diseases of the heart are not really active diseases at all, but are defects in the valves, due to the shrinking of scar tissue, which permits a back-flow of the stream.

Valvular heart defects used to be considered quite dangerous, but we have learned that they are not so serious as they were formerly thought to be. A heart will go on performing its task in spite of a valvular defect, if the heart muscle is strong enough to force the stream onward, and, also, if the heart is not given too much extra duty to perform.

The heart muscle may be weakened by several causes; by disease, by overwork, or by undernourishment. There is a large artery which distributes its branches over the heart, conveying nourishment to the heart muscle. A disease of this artery may cause starvation of the heart muscle and produce that terrible condition called angina pectoris. But whatever symptoms may arise from heart exhaustion, the one constant symptom is shortness of breath.

Shortness of breath is an expression of air hunger. If we do not get sufficient oxygen in the tissues there is an accumulation of carbonic acid gas in the blood. We may not get enough oxygen because of something wrong with our lungs. Or we may get enough oxygen through our lungs, but the blood stream may be too sluggish for the tissues to receive it. This is the reason why, in diseased conditions of the heart or blood vessels, we breathe rapidly, even when at rest, or pant and labor upon the slightest exertion. It is a danger signal of great gravity, and requires immediate attention.

If you cannot climb a hill as comfortably as you used to; if going up a few steps causes distress, you would better take good advice from one competent to give it. It may be that you are getting too fat, that there is fat around the heart, and it is struggling against an incubus. But, on the other hand, it may be a weakened, exhausted condition of the heart muscle, which requires rest.

Impairment of the circulation in the vessels is frequently caused by hardening of the walls of the small arteries and the obliteration of many capillaries, which occurs mostly in old age. This obliteration of the

small vessels is considered to be one of the causes of high blood pressure.

Another cause is a chronic disease of the kidneys. Recently another theory of the high blood pressure has been widely accepted. On the surface of each kidney in man and animals is a gland called the suprarenal gland. The extract from this gland, called suprarenalin, when injected into the blood, causes increased blood pressure. This has led to the belief that in chronic diseases of the kidneys the suprarenal gland is affected, and suprarenalin is increased in the blood.

What is meant by "high blood pressure"? Nowadays, when you go to the doctor, one of the first things he does after getting your story is to put a cloth band about your arm, containing a rubber air bag, which is connected by a rubber tube to a small instrument consisting of a dial and a hand that registers the amount of air pressure in the rubber bag. By squeezing a bulb and pumping air into the bag, he compresses your arm and finally stops the beating of the pulse on that side. Then, with the finger he feels the wrist artery, or with a stethoscope he listens at the crook of your elbow and notes on the dial the exact place where, upon gradually releasing the air pressure, your pulse first reasserts itself. The figure on the dial at this point is put down as the amount of your blood pressure.

Too many people are worried about their blood pressure. The healthy heart has a tremendous reserve power beyond what it is called upon ordinarily to use. The normal heart can endure almost any amount of physical exertion that does not cause distress elsewhere. If one has a high blood pressure there must be a reason for it, and to attempt to reduce the blood pressure would be folly. It would necessitate reducing the force

of the heart contraction, which is needed to send the blood out into the body and get it back again.

If you have a high blood pressure your doctor will try to find out three things about you: Are your kidneys performing properly? Are they taking enough waste matter out of the blood? If not, then you may have a chronic kidney disease that needs attention and care. How are your artery walls? Are they beginning to harden? What is the condition of your heart muscle? Is your heart equal to the added task? If he is satisfied concerning these three things you need not worry so much about your blood pressure.

All the drugs in the world cannot keep the blood pressure down, anyhow. Only one thing can do it—a failing heart muscle. If for some time it has been around one hundred and eighty or two hundred, and suddenly drops, look out! The heart muscle is getting tired. It must rest or it will stop.

But because anxiety and stimulating foods will add to the burden of the heart, the wise doctor will tell you to forget your blood pressure, to rest, to restrict your diet, and to reduce your allowance of tobacco, or coffee, or tea.

One of the most important conditions that affect people of advancing age is arterio-sclerosis, or hardening of the artery walls. If you will put your finger on your pulse at the wrist you will feel the impulse of the advancing blood wave, which causes a momentary stiffening of the wall. If you press a little harder you will be able to collapse the wall until the pulse is obliterated. When a doctor examines your pulse he wants to know much more than how fast it beats. In fact he learns five things about it: First, the rate; second, the volume, whether it is thin and

fine or a full blood stream; third, the rhythm, whether it is regular or irregular; fourth, how much pressure is required to stop the pulse; and fifth, the condition of the artery walls.

If they are soft and smooth, no marked degenerative changes have taken place. But the wall may have a hard, inelastic, ringed feel, very much like the feel of a rubber hose protected by wire sheathing. This last is an indication of an advanced state of arteriosclerosis.

In general, it may be said that anything which causes over-activity of the heart puts a strain upon the blood vessels. The anxiety, the worry, the feverish haste of modern life, overeating, overdrinking, the excessive use of tobacco, all of these, singly or in combination, may produce an untimely hardening of the vessels. And when the vessel walls are hardened, they are more easily ruptured, especially because there is usually increased blood pressure. Ruptures occur more frequently in the brain than elsewhere in the body, and when this occurs there is a hemorrhage on the surface or within the brain which is called cerebral apoplexy.

We have been talking about the pump and the piping system. Now we must consider the pumper. Anywhere along the course of the great heart nerves, a trouble may arise to cause a change either in the rate or the rhythm of the heart contraction. Such conditions are not usually serious, however, unless the trouble occurs in the nerve filaments *after* they have entered the heart itself.

SIX

WHY THIS HEADACHE?

IT WOULD be difficult to find anyone to speak a good word for a headache. If the whole tribe of headaches of all kinds and degrees could be banished by popular vote there would soon be a Twentieth Amendment to the Constitution. And the votes in favor of the amendment would be cast not only by those who are subject to headaches but also by the people who suffer from the headaches of others.

These would include, of course, all immediate relatives and friends. Nothing makes one more disagreeable and uncompanionable than a headache. Few things so upset the harmony of a home or so threaten the integrity of friendship. Few things so retard the machinery of business. It is the great destroyer of efficiency. If such a computation were possible it would be interesting to know concerning any community the number of hours lost in a day, a week or a year because of headaches. And if happiness, peace, good fellowship, harmony, if these could be weighed or measured, the figures representing the total loss would be appalling.

But just as no one is entirely good or wholly bad, so headaches are not an unmixed evil. They have their uses if we would only stop to realize it. Sometimes one is unfortunate if he does not get a headache. For instance: There are people, nearly everyone knows at

least one such person, who never have a headache. No matter what they do they seem to get off scot-free. And they are not loath to boast about it, as though the fact proved them to be possessed of some virtue or superior quality not belonging to others. Perhaps this kind of person has not become entirely extinct, but he was more in evidence before the Eighteenth Amendment was ratified. The morning after the night before he was especially obnoxious to those who had been out with him and who suffered. They hated him for his boisterous gayety and his attitude toward them, a mixture of pity and superiority, and they envied him. Lucky dog!

Not so lucky, after all. Possibly not so lucky as the fellow with the headache. For the feeling of security from punishment causes the one to go on repeating his crimes against health, while fear of the headache deters the other. This merely by way of indicating one of the uses of a headache. It needs less emphasis now than it did a while ago. But it has its application still. An overloaded stomach, indigestion caused by rich foods, will produce this kind of headache also, especially if augmented by excitement, by much coffee and by much smoking. If the headache comes, let it be a warning. That road, dotted by the pleasant roadhouses of self-indulgence, leads to destruction. Headaches have their advantages then; they are not always an unmitigated evil. In fact, very few of them are, if they serve their purpose, which is to warn us that something is wrong that needs correction. Almost every abnormal condition, either temporary or permanent, may cause a headache.

These causes are so numerous that it would be impossible to mention them all. Among them are a blow

on the head, bad vision, acute febrile disease, indigestion, chronic kidney disease, a stuffy air-tight bedroom, nervous shock, a tight collar, catarrhal conditions, tumors of the brain, a bad liver, inflammation of the brain's lining membranes, and long-continued, intense mental effort. Also, migraine, which may be considered a condition in itself.

But with the exception of some of the organic brain diseases, and of that most distressing affliction, migraine, practically all the conditions causing headaches fall into two groups—those arising from bad habits and those due to bodily defects. Perhaps this statement needs some clarification. By bad habits is meant harmful habits, environments and occupations. By bodily defects is implied any condition in the body which causes irritation of the sensory nerves that reflexly affects the brain. Examples of this are defective vision and catarrhal conditions of the nose and its accessory chambers.

Before taking up particular headaches and their causes it may be of interest to inquire what a headache is. Pain of any kind is always due to irritation of the nerves of sensation. These nerves are the wires of communication by which we receive our impressions of external things. They are distributed in the greatest number upon the surface of the body and all have their central station in the brain.

Protected by its bony covering the brain does not come into direct contact with the outer world, except as a result of injury. It is surrounded, first by two delicate membranes, then by a denser fibrous coat, and finally by the thick, rigid arch of the skull. It is the central nerve station, in charge of which are the higher mental faculties, the will, reason, imagination, all the

attributes which together form consciousness and intelligence.

To this station in its dark chamber come all communications from without, along the main trunk, the spinal cord, and by special wires from the organs of sense. And from it radiate commands to every part of the body. In response to messages which it correlates and interprets, will pushes the buttons, currents of impulse flash along the motor wires, and the result is action at remote stations to which the orders go.

Pain, then, is perceived by the brain, but the brain has no sensory nerves of its own. Once the surgeon's knife has penetrated its membranes large portions of the brain could be removed without the need of an anæsthetic. But there are nerves of sensation in the head, and a headache from any cause, near or remote, is directly due to pressure upon or irritation of these nerves. Among other things, increased pressure within the skull may cause a headache. A brain tumor will do it, especially if it is near certain locations where the sensory nerves are distributed in greatest numbers; so will an abscess, and inflammatory thickening of the membranes, as in meningitis. This last is the cause of the most excruciating of all headaches.

Too much blood in the head will also cause headache. There are two kinds of congestive headache—one in which too much blood is pumped into the head, and the other in which too little gets out. The former is the violently throbbing headache; the vessels are distended, the volume of blood is increased and there is a throbbing pain as each succeeding wave beats against the sensitive nerves. In the latter, where there is merely a damming up of the blood, the pain is not

so acute and the throbbing sensation, if present at all, is not so marked.

Irritation of the sensory nerves in the brain is nearly always due to the presence of unwonted chemical substances in the blood. These poisons may be made in the body or they may be introduced into it from the outside. The headache following a convivial evening is really due to both kinds of poison. The alcohol has caused indigestion and fermentation with the production of irritating substances from the food. But the alcohol itself is also an irritant to the nerve centers. Together they greatly increase the circulation of blood in the head, and the blood stream beating against the sore nerves produces the regular old-fashioned throbbing headache.

Coffee is less poisonous than alcohol, but, nevertheless, it is a mild poison. And so is tobacco, but repeated use of both develops a tolerance to them. Even after this tolerance has been established an overdose of either will cause disagreeable symptoms, such as sleeplessness, nervous irritability and headache. The coffee headache is usually chronic—that is, it is either constant or it reappears often without apparent cause. The cause may not be even suspected until in desperation one stops drinking coffee and the headaches gradually disappear.

We are constantly making poisons in this chemical laboratory of the body, and the excretory organs are continually throwing them off. As long as they are not manufactured in excess and the scavenger organs are efficient the balance is maintained. But if elimination cannot keep up with production, if the kidneys, the sweat glands and the lungs are unable to get rid of the waste products, the result will soon be disastrous.

Often the first and only symptom of this condition is headache.

A good example of the headache of self-poisoning is that which occurs after one remains for some time in a close room. You may recall at least one such experience of your own. You were, possibly, attending a meeting. All the windows and doors were shut and a lighted stove or two helped the audience to burn up the supply of oxygen in the atmosphere. At first you were interested in the proceedings, but soon your attention began to lag. You became drowsy, so sleepy that you could keep awake only by the greatest effort, by fidgeting and by frequently pinching yourself. And toward the end you had a headache.

You were poisoned by carbon dioxide, a gas produced by combustion in the body by exactly the same chemical process as elsewhere. With each expiration you throw it off, and with every inspiration you should take in oxygen. If the supply of fresh air is limited it soon becomes depleted of oxygen and saturated with carbon dioxide. And the longer you breathe this vitiated air the more of the gas remains stored up in the blood to act as a poison upon the nerve centers of the brain.

This illustrates a very simple form of poison headache which may occur in any healthy person. There are many other poisons than carbon dioxide. In the process of living we manufacture them constantly. The mere act of living implies energy, and every form of energy, whether of mind or muscle, requires combustion. Also, combustion necessitates something to burn up and a constant supply of new material. Tissues are destroyed, they are restored by the food that we eat, and the waste products must be removed.

The blood not only supplies new material but carries away the waste, which must be thrown off by the excretory organs, chiefly by the kidneys and the skin. Perfect health requires a nice balance between the amount of waste manufactured and the amount eliminated.

Physical energy increases the waste but it also accelerates the flow of the blood stream, which in turn stimulates the kidneys and the skin to greater activity. Mental energy increases the amount of waste material, also, without a corresponding effect upon the excretory organs. In consequence, long-continued mental work, especially if accompanied by worry, without sufficient physical evercise, will eventually result in the accumulation of poisons.

Constantly eating more food than is required for replacement of tissue and for the production of heat is another way of upsetting the balance. Unassimilated food must be gotten rid of either by burning it up or throwing it off as waste. A headache from overeating can often be cured by vigorous exercise because the increased energy requires more fuel and the skin and kidneys throw off more waste.

Another way to poison the body is to decrease the eliminating power of the kidneys. This can be done by continually giving them too much to do. Their structure is very delicate and yet it is not easily destroyed, but long-continued abuse will do it. After a long time in the constant attempt to get rid of an excess of waste material they will finally break down, and then they will be unable to take care of even the ordinary amount of waste.

Usually following close upon the heels of these changes in the kidneys come high blood pressure and hardening of arteries, and together they form a most

unpleasant triumvirate. Before any of them appears it would be well for us if we could interpret the occasional poison headache as a warning.

Headaches from bodily defects may be called reflex headaches. They are caused by irritation of nerves somewhere along their course outside the head, which by the connection of these nerves with the brain is communicated to the nerve centers. Most conspicuous among these are eye headaches, catarrhal headaches and those peculiar to women.

A far greater number of women than men suffer from headaches for at least two reasons. As a rule they are more emotional. Emotions not only cause headaches but they can aggravate those which arise from another source. This is because they have so profound an influence upon all the physical functions, especially upon the circulation. Grief, excitement or sudden shock may start a headache or make an existing one worse.

But women are especially liable to headache because of physical conditions directly incident to their sex. Many of them go on suffering year after year when proper treatment or a simple surgical operation might relieve them.

Eyestrain as a prolific cause of headaches is so generally recognized that little need be said about it, but a few practical suggestions may be helpful.

The perfectly normal eye may be overworked. It requires an effort of the ciliary muscle to thicken the crystalline lens in order to focus near objects on the retina. For this reason long-continued work tires this little muscle and the result may be a headache, which a short rest will cure.

Many of the eye headaches come from farsighted

eyes. The ball being too shallow in this defect, the crystalline lens must assume a state of extreme thickness for near objects in order to throw a clear image on the retina. One with a farsighted eye must always wear glasses when looking at close objects.

When the front of the eyeball is irregular in shape, as it is in astigmatism, all efforts of the crystalline lens to obtain a clear image are fruitless. Struggle as it will, and it struggles continually, the result is always a blur. Those who have astigmatism must wear glasses all the time. The practical application of this fact is that the astigmatic person cannot obtain relief by keeping his glasses in a bureau drawer or on his desk. The mere fact of owning them will not be much help.

Another suggestion has to do with the headaches of school children. Parents often think that they are imaginary or invented for an obvious purpose. Such headaches may belong to the poison group, from bad air in the schoolroom; but they may, and most often do, come from the need of glasses while the child is in school.

The third suggestion concerns the occasional failure of glasses to relieve the headache. Sometimes the astigmatism is so complicated that it is not entirely corrected by the first prescription, and a further examination may be necessary.

Headaches from catarrhal conditions are due to pressure on nerves in the nose or its accessory chambers. These chambers, or sinuses, are connected with the nose by more or less narrow and tortuous channels. They are lined with mucous membrane and are susceptible to all the infections that attack the nose itself.

When these membranes are swollen or when a sinus

is filled with mucus or pus the nerves are compressed and the result is usually a dull headache, but occasionally the pain is acute if the pressure is very great.

Granting, then, that headaches serve a purpose and that the purpose is to warn us of conditions present and of further trouble to come if the warning is unheeded, does the kind of headache indicate the condition which causes it? Not definitely, and yet it may serve as a clew. There are many kinds of headache, but for present purposes they may be classified as throbbing and dull. Of course this is purely arbitrary, for any headache may change in character from time to time. And, also, the same cause may give rise to different sensations in different people and at different times.

The congestive or throbbing headache is usually caused by an acute condition. It occurs in the beginning of fevers, especially those which, like pneumonia, have a sudden and violent onset. It is the headache of acute indigestion, of alcoholic poisoning and of highly emotional states. If the congestion is very severe it may be accompanied by vomiting, caused by the intense pressure within the skull.

Dull headaches are the predominant type in more chronic conditions, as, for instance, those in which there is a slow absorption of poisons. It is the headache characteristic of chronic constipation or kidney disease and of hardening of the arteries. At times there may be attacks of throbbing or acute pain, but usually there is a dull, stupefying sensation. Also, in chronic catarrh and in defective vision the headache is mostly dull.

Sometimes the location of a headache helps to indicate its origin. If the pain is always in the same place,

a comparatively small spot in the head; if it is continuous, grows worse from month to month, and is more severe at night—it may be due to some organic trouble in the brain. This may be a tumor or an abscess within the skull. It does not necessarily follow that so grave a condition is present, but at least the sufferer should have a competent nerve specialist find out. In catarrhal conditions the discomfort is worse in the front of the head. The poison headaches are more diffuse but the pain is more often in the forehead and the back of the head. The top of the head is favored by the headaches of nervous, hysterical persons and by those suffering from stomach and liver conditions.

There are several special forms of headaches, each in a class by itself, of which only two will be described —the neurasthenic headache and migraine. Neurasthenia is a word which carries with it a certain amount of opprobrium. A doctor never tells his patient that he or she is neurasthenic, not if he wishes to keep the patient. In the minds of most people it is synonymous with hysteria and implies a certain mental or emotional weakness. Neurasthenia, however, means merely nerve weakness, exhaustion. It is a condition caused by long-continued mental strain, abuse of the mind, usually coupled with neglect of the body.

The neurasthenic headache is in a class by itself, not because it is so definite in its manifestations but rather because it is so multiform, so changeable and so persistent. It takes a long time and much persistence to develop neurasthenia and, having achieved it, a long time to get rid of it. Those who acquire it are, contrary to popular belief, mostly the brain workers, the ambitious, those who struggle against odds and who usually come off victorious at the expense of health.

Because it has so many manifestations in different individuals the neurasthenic headache is difficult to describe. There may be no acute pain at all. More often it is a feeling of oppression and heaviness in the head. The pressure may be located in the forehead, extending to the eyes, or it may involve the whole brain. At times only the back of the head is affected, but always there is the sense of fullness and weight.

Other sensations are also variable; the head feels hollow, or numb, or hot or cold. If there is actual pain it is usually not severe or continuous. There may be a sensation of heat all through the brain, with a throbbing as though the head would burst if it were not bound tightly with a bandage; or a sense of constriction as though an iron band were around it. But, however various the symptoms, the neurasthenic headache has two definite characteristics: It is persistent—it may not be always present but it returns on the slightest provocation; and, especially, it is aggravated by mental work and worry.

This is a headache of poisons, slow poisons manufactured in the body and stored in the brain. By their slow, cumulative action they effect changes in the cerebral circulation, chief of which is a gradual dilatation of the blood vessels. There is always too much blood in the brain, not a swift-moving stream like that which causes the violently throbbing headache of active congestion, but a sluggish current which produces pressure.

The longer the causes of this condition are allowed to persist the more difficult it is to cure. Finally organic changes may occur which cannot be cured; the vessel walls, on account of long-continued distention, will become thickened, and their soft, elastic tissues

replaced by lime salts. In other words, cerebral arteriosclerosis.

But long before these changes have occurred, long before this poison headache has become neurasthenic in character, its repeated warnings should be heeded if one wishes to be sure of averting organic changes in the cerebral vessels and all that these changes imply.

Medicines will not cure, they will only relieve momentarily. In fact, they are worse than useless as they mask the real condition. The essential thing is rest, absolute freedom from the environment and occupations which brought it on. And the duration of the rest must be determined by the length of time the condition has lasted. Short vacations are of little benefit. In fact, they are not of much use to anyone who needs a complete rest, because he usually speeds up his work before he goes away and makes up for his absence after his return.

The best way to cure a neurasthenic headache is not to get it. There are a few people who are extremely susceptible because Nature has endowed or cursed them with a nervous, irritable temperament. But even these unfortunates can avoid trouble by tempering work with play, intense application with recreation.

There is only one migraine, although many different forms of paroxysmal neuralgia are mistakenly called by that name. It is one kind of headache about which nothing good can be said. It does not warn one of any danger to be avoided; in fact, it serves no good purpose whatever. Its victims are innocent, they have done nothing to merit punishment and they can do nothing to avoid it.

So many times a month or a year the sufferer spends a day or longer in a darkened room, shut away from

friends, from all the activities of life. It does not usually strike suddenly. For some time, perhaps for a day or two before an attack, there are premonitions. Usually these take the form of mental depression, lassitude or perhaps occasional chilly sensations, or there may be changeable emotional states, alternate exaltation and moodiness. Anyone who suffers from attacks of migraine knows what these signs portend.

Then curious visual phenomena may appear—spots of blindness, half vision, flashes of brilliant light or zigzag lines. Sometimes the attack wastes itself in these threats, but when it does materialize it eclipses every interest in life. The pain is agonizing. It begins usually over one eye but may spread rapidly so as to involve the entire half or even the whole of the head. It is intensified by the slightest jar, by light, by any sudden noise. It is throbbing, piercing, stabbing, blinding. During its height there may be mental confusion, even torpor. The sufferer's face is pale, pinched and drawn, every line and feature depicting agony.

At the climax there is nausea, and the vomiting may be so violent that bile is brought up from the small intestine. This fact has caused some to call migraine "bilious headache," but the bile is merely brought up mechanically by the retching, and the liver has nothing to do with the attack.

These distracting symptoms may last an hour, a day, or in some instances several days. Then relief comes suddenly and with as little apparent cause for its coming as had the attack itself. Usually the sufferer falls into a natural sleep, from which he awakens perfectly normal.

The causes of migraine are obscure. About all that is known is that with many it seems to be heredi-

tary, affecting perhaps one person in each succeeding generation of a family; and that a single attack may be precipitated by conditions which bring on other headaches—indigestion, excitement and overwork.

There seems to be some resemblance between migraine and epilepsy. In the latter disease the attacks are sudden and apparently without cause. The victim utters a cry and falls unconscious, his muscles rigid. This is followed by spasmodic jerking, and after a short period the storm passes as quickly as it came.

Epilepsy is a nervous explosion affecting the motor centers, and migraine is thought to be a similar explosion, the seat of which is in the sensory centers of the brain. But whatever the theories as to its origin, one thing is quite sure—nothing good can be said about it.

With the exception of migraine the severity of the attacks of headaches can be mitigated by drugs. Nearly everyone has his favorite remedy, which he keeps on hand for emergency. Headache medicines vary much in name but little in their ingredients.

The old-fashioned methods for relief are safer, although they are not so prompt in their action—a laxative to remove poisons from the system, and the application of heat and cold. Both heat and cold are useful in the acute congestive headache, cold compresses to the head to drive the blood elsewhere, and a hot foot bath to distend the blood vessels in the extremities and draw the blood from the head.

The headaches of chronic poisoning are benefited by a course of laxatives and by sweating. Both of these methods aid in getting rid of the poisons. A headache from acute indigestion is best relieved by vomiting or, if the stomach contents are acid, by neutralizing

them with half a teaspoonful of baking soda in hot water.

Sometimes neuralgic pains are better for heat, and at other times for applying ice to the affected nerves. There is no way of knowing which to use except by trying.

If the purpose of this article has not utterly failed it must be evident by this time that a headache is not a condition in itself, but a symptom. It is a protest, occasional or often repeated, mild or loud and mandatory, because something has been done that should not have been done or something is wrong which needs correction. Consequently prevention is infinitely more important than cure.

Another thing to remember is that the mildness or severity of the pain is not usually an index to the gravity of the condition producing it. An occasional severe headache is usually due to a temporary disturbance and is merely a warning not to repeat the indiscretion that brought it on. On the other hand, repeated mild attacks may indicate serious trouble which it would be well to discover.

The proper way to regard a headache is to take it neither with stoical philosophy as something inevitable, nor on the other hand with querulous and futile complaining, but to make a proper and consistent endeavor to find out what is wrong. In the majority of instances this search for a cause will require expert help. It may necessitate a very thorough physical examination. But surely the end to be attained, which is not only greater happiness but a possible increase of years, is worth all the effort.

The one thing not to do, however, is to trust solely to pills and powders and potions which relieve but do

not cure. They give a sense of false security. By deadening our sensibility to pain they make us feel safe in the presence of danger. Or they tempt us to go on doing things that are harmful because we can postpone the penalty.

If we think we can dance and not pay the piper we are wrong. Sooner or later the piper must be paid. And the longer payment is put off the more usurious the interest he will charge.

SEVEN

SYMPTOMS AND SYMPTOM HUNTING

PATIENTS will not discuss their symptoms." Those who frequent or who casually visit hospitals and sanitariums may have noticed a sign bearing these words conspicuously displayed in the rooms where patients gather for social converse. Worded as above, it is neither a statement of fact nor a credible prediction. Patients do and will discuss their symptoms, with or without permission. What the sign really means is: "Patients, please do not discuss your symptoms any more than you can help. But especially do not listen to symptoms, because they are catching."

The only pleasure one gets out of having symptoms is in telling about them. Consequently exchanging symptoms is the principal indoor sport wherever the afflicted are gathered together. One curious rule about the game is that though you give a symptom to your opponent and get one of his in return, each of you has all his own symptoms and one more.

The kind meant here is sensations, or subjective symptoms, those which you yourself experience. Those perceived by others are called objective. They are closely allied, and each can give rise to the other. For instance, if you feel ill even the least observing of your friends will soon note the fact in your appearance—and vice versa. You may start the day with the delusion that you are perfectly well. If you think about

it at all you know that it's a great day and you have plenty of work to do and you are going to it. Then let several friends in succession remark with concern that you are not looking well, or vaguely imply it by asking you how you feel and if anything is wrong with you. Subjective symptoms will now appear which you had not previously noticed. It may require considerable exertion of will to forget them.

Subjective symptoms are like children, in that too much indulgence spoils them, makes them willful, obtrusive and generally obnoxious. On the other hand, they should not be entirely neglected, but should receive proper attention and be kept in their proper places. For the loud, boisterous kind is not necessarily more mischievous than the quiet ones. In fact the latter, being usually the more neglected, are the more likely to cause trouble.

By sensations alone no one, not even the most experienced physician, is able to decide what is wrong. He must use his trained faculties of observation, and often he must call to his aid all the latest laboratory methods—chemistry, the microscope and the X-ray. One cannot write a long detailed account of his symptoms to a physician and get a diagnosis by return mail. The doctors of long ago were shrewd guessers, because often they were compelled to guess, not having the benefit of modern scientific methods.

Patent-medicine manufacturers still fool the credulous, but they are deluding fewer every year. The old medical almanacs were the crudest but most popular in their appeal. Who does not remember the kind that had on its title page the cut of a human figure, with none of its inner works concealed, surrounded by the signs of the zodiac, from which lines converged to

direct the reader's attention to the various parts of the anatomy? The other pages were filled with assorted symptoms, of which you could take your choice and send for the remedy at so much a bottle or box. This kind of advertising was successful for two basic reasons: First, a nervous, introspective person can be made to magnify his troubles—even to adopt symptoms if he has not enough of his own. Second, subjective sensations may mean very little or a very great deal. They may indicate conditions easily remedied or those which are exceedingly grave.

This last fact is the text upon which this article is based. In the attempt to prove the truth of the statement we shall have to discuss certain symptoms in spite of the injunction quoted in the beginning. We shall limit ourselves to a very few of the many and various sensations to which the ill may be subject. They will be cited merely in proof of two corollaries to the original proposition. The first is that any given symptom alone is of little help as a guide in determining its physical cause. The second corollary is that the severity of a symptom is not a reliable indication of its gravity. Stated otherwise, Nature does not always warn us through a megaphone; her often-repeated whisper may be more significant than her loudest shriek. For purposes of illustration, let us select the following seven symptoms from any medical almanac:

"Do you suffer from dizzy spells? Have you specks before the eyes? Backache? Pain about the heart? Palpitation? Shortness of breath? Are you nervous and despondent?"

The last question in the list is the stinger in the tail. Of course you are nervous and despondent if you have any of the other symptoms and you get the suggestion

intended, that they indicate serious organic disease. But do they? Not always—in fact not usually.

If symptoms are so indefinite, how is one to tell what are important and what unimportant, which to regard and which to disregard? The answer is quite simple—one cannot decide from them alone. But it is equally true that in every case where certain symptoms, however mild, persist or recur repeatedly, they should receive attention.

Taking up the sample symptoms previously mentioned, not in the order of their frequency or importance but simply in the sequence in which they happened to be set down, we shall begin with dizziness, or vertigo. It is certainly a disagreeable sensation, and may range all the way from a mere momentary dizziness to a sickening giddiness which makes one wholly unable to stand or even to sit upright during an attack. The causes are various—bad vision, bad liver, bad habits—from these comparatively easily corrected conditions to changes in the brain.

It is not an uncommon occurence to have a slight dizzy sensation after a full meal. By disturbing the equilibrium of the circulation a heavy stomach may make a light head. Chronic poisoning is also a possible cause, whether the poisons come from without or are manufactured in the digestive tract. Alcohol, coffee and tobacco may produce attacks of vertigo, and so also will poisons of putrefaction in the stomach and bowels. When the blood is saturated with them they act directly upon the brain, disturbing the centers by which equilibrium is maintained.

The onset of an acute disease is frequently heralded by dizziness, due to the action of germ poisons upon the nerve centers. The attacks may recur during its

whole course until convalescence, when the supply of poisons ceases and they are eliminated.

Brain pressure from tumors, or thickening of the membranes, or from excessive secretion of the cerebrospinal fluid may be an exciting cause. But in this case the attacks are persistent, severe, and are accompanied by other symptoms indicating very profound disturbance.

There is a peculiar, comparatively rare disease of the inner ear called Ménière's disease, the chief characteristics of which are vertigo, ringing in the ears, impaired hearing and nausea. As all these symptoms must be present to complete the picture, the condition is mentioned only because of the peculiar mechanism by which the giddiness is produced.

Part of the inner ear consists of three small bony tubes, called the semicircular canals.

They communicate with each other by several openings into a small bony chamber, and through them circulates a fluid in which float filaments of the auditory nerve. The free movement of this fluid has a great deal to do with the sense of balance.

In examining recruits for the air service during the war stress was laid upon their ability to balance properly; to determine whether in the dark or up among the clouds they would be able to know if they were upright or upside down. This sense of balance has its seat almost entirely in the semicircular canals.

In determining his fitness for flying the candidate was placed in a revolving chair, his eyes bandaged and his head bent forward, so that one of the semicircular canals in each ear was in a horizontal plane. In this position he was turned a certain number of times in one direction. Then when the motion was stopped and he

was told to sit up straight he made frantic efforts to fall over in the direction opposite to that in which he had been moving. That is, after having been turned to the right he fell toward the left.

Now this is a perfectly normal reaction, though the boys were usually much chagrined. They thought, until reassured, that their chances for acceptance had vanished. The rotary motion causes a flow of the lymph stream, at first very slow, but gradually increasing until its speed equals that of the body. But when the body stops there is an interval during which the fluid keeps on moving. During this period the brain registers the movement as of the whole body, and it is impossible to keep one's balance.

This phenomenon may be elicited by anyone in a very simple manner. First, however, select a wide space, unencumbered by breakable or sharp-cornered objects—preferably outdoors, where the grass is long or the ground soft. Next, have several friends close by, well distributed, to catch you. Hold a cane or umbrella upright, its ferrule on the ground. Put both hands on the handle and, bending over, rest your forehead upon your hands. Shut your eyes, and with your head as a pivot turn around this perpendicular support, say, about ten times. Then suddenly straighten up, open your eyes and walk briskly toward an object previously fixed upon as a goal. If you go straight to it there is a chance that something is wrong with your semicircular canals. But you won't do anything of the kind, so why worry?

Ménière's disease is rare, and is mentioned here as an example of a grave condition which may cause vertigo. But slightly increased pressure of the fluid

in the semicircular canals will upset one's sense of balance and bring on mild attacks of dizziness.

Any condition which causes temporary changes in the circulation of the blood in the brain may give rise to vertigo, and consequently it is not an uncommon symptom with those of middle age or beyond, who have hardening of the arteries and high blood pressure. Mostly there is merely a sense of fullness, with a fleeting giddiness, felt on exertion or upon stooping over. Many conditions far less grave produce attacks of greater severity. But nevertheless it is Nature's warning whisper and should be heeded.

With those under forty-five a frequent cause of dizziness is defective vision. There are three kinds of defective vision due to the shape of the eye—short sight, far sight and astigmatism. The normal eye is a perfect camera. Rays of light from objects are slightly converged as they penetrate the cornea, the transparent front of the eye. In passing through the crystalline lens they are still further converged, so that they are brought to a focus upon the sensitive plate—the retina. The crystalline lens accommodates its shape to focus near or distant objects. It becomes thicker, more convex, when one looks at something near, and resumes its relaxed, flattened shape when one looks at a distance.

This thickening of the lens is accomplished by the contraction of a small muscle. If you are looking through the window the image of an object on the pane is blurred. It requires an effort of the ciliary muscle to thicken the crystalline lens so that the near object may be clearly seen.

But very many eyes are not normal; some are too deep, some are too shallow, and some have lenses

irregular in shape. If the eyeball is too deep, light rays focus before they reach the retina and they must be diverged before they enter the eye, unless the object to be seen is held close. One with this defect is near-sighted and must wear concave glasses to see clearly distant objects.

If the eyeball is too shallow the rays from near objects would focus behind the retina if it were not for constant effort on the part of the crystalline lens. Farsighted persons, when reading, writing or sewing without glasses, are constantly subjecting their eyes to strain.

There is another common defect which does not depend upon the depth of the eyeball. Its transparent front, the cornea, may be irregular in shape—that is, it may have a different convexity in different diameters. With such eyes, no matter how distant or near the object, there is never a clear image without artificial aid. In what is called farsighted astigmatism the crystalline lens struggles frantically to focus the light rays, but without avail. Those who have this defect must wear glasses for both near and far vision.

Eyestrain, especially from farsighted astigmatism, may cause many and various symptoms—inflammation of the ball and lids, headache, nervous irritability, dizziness, even attacks resembling true epilepsy—any or all of which may be banished by adopting the very simple expedient of procuring glasses to correct the vision.

There are two important points about vertigo and its causes to be remembered: First, that an occasional attack may occur in the healthy person from overeating or some other indiscretion; second, that its severity or mildness does not indicate the gravity of the cause.

Persistent recurrences of a mild form of dizziness are more significant than a single instance of much greater violence. In the latter case watch your diet; if the attacks recur get competent medical advice. But in any case vertigo is a signal that something is wrong which needs correction.

There is a fairly widespread belief that specks before the eyes indicate a serious organic condition, usually of the kidneys or liver. An imaginative physiologist long ago gave them the name muscæ volitantes, or flying flies. They assume various shapes, dots, slightly luminous circles and twisted hairs, and are best seen against a gray background. They are elusive; one cannot look directly at them; they float across the field of vision and will not stay still; in a moment they are back again, and in a moment gone.

The eye has two chambers separated by the iris—the curtain with a circular hole in it to admit the light, and the crystalline lens. These two chambers are filled with transparent fluid which is not altogether homogeneous. The fluid in both chambers contains minute particles of slightly greater density that throw shadows upon the retina. These are the elusive flying flies which float back and forth across the field of vision.

They may be perfectly normal, being present in nearly all eyes. We do not notice them when we are well, but when sick, tired or nervous they obtrude themselves upon our notice, and are especially obnoxious after long-continued abuse of the eyes. That is the sum of their significance.

But black specks which are fixed are of more serious import. If there is a black spot in the field of vision, constant, always in the same relative position to the object upon which the eyes focus, it may be due to one

of several causes. There may be a scar on the front of the eyeball; it may be that the retina is partially detached from the back wall of the eye; there may be an advanced kidney disease or an inflammation of the optic nerve.

Pain in the small of the back is often attributed to the kidneys. Discomfort in this locality may be a continuous more or less aching sensation or a sharp cutting pain aggravated by the slightest movement. When it assumes the latter character it is nearly always a rheumatism of the muscles and ligaments along the spine, called lumbago. But whatever the cause, whether rheumatism or injury from a fall or from lifting a heavy weight, or exposure to a draft when one is overheated, it does not often indicate a serious condition. One important fact to be remembered is that chronic disease of the kidneys does not cause pain in the back, notwithstanding the general belief.

Pain in the left chest is equally misleading. Because it is near the heart that organ is frequently accused when entirely innocent. If the pain is severe apprehension may cause rapid heart action, which seems to confirm the suspicion against it. Usually the first time this symptom appears the doctor is sent for posthaste.

"Doctor," the patient manages to say in gasps, "my heart—terrible pain—do something quick!"

But the doctor, undisturbed, proceeds with his examination, and finally announces that it is not the heart at all, but intercostal neuralgia, or pleurisy, or rheumatism of the muscle between the ribs, or indigestion.

Then the heart, reassured, stops its wild pounding and goes about its ordinary business, its former activity having been increased by fear.

Pain in the chest wall coming on suddenly without other symptoms is usually caused by conditions other than heart disease. Its location near the heart is purely incidental. When it occurs on the right side of the chest there is not nearly so much anxiety.

The heart has no nerves of sensation. If the surgeon could get to it without cutting through the sensory nerves on the surface of the body he could operate upon the heart itself without causing pain. And yet pain is sometimes a symptom of heart disease, but it is produced in a roundabout way.

Two great nerves keep up the heart's movements. One, the accelerator nerve, supplies the stimulus to contract; and the other, called the vagus, regulates the speed. When these two nerves are acting equally the rate of the heart-beats is normal. The vagus is also called the pneumogastric nerve, because it supplies the stomach and lungs. But vagus is a more appropriate name, because it means wandering, and the vagus wanders to most of the vital organs. Branches go to the ear, the throat, the bronchial tubes, the stomach and the heart, and all of these it supplies with sensory fibers, except the heart.

If the heart cannot feel, how can there be pain in heart disease? Branches of the heart nerves go to certain sub-centers in the spinal cord, and there they connect with the superficial nerves of sensation. Continued irritation of the heart nerves is thus communicated to the surface nerves, and there is reflex or referred pain, not in the heart but in the chest wall over which the sensory nerves are distributed.

True heart pain is always due to exhaustion of the heart muscle and may be recognized by the presence of other symptoms. It is made worse by the slightest

exertion; by anything that increases the rapidity of the heart's contractions. And nearly always the respirations are labored and deep, expressing the desire of the sluggish blood stream for more air. But the pain is in the chest wall, never in the heart.

More significant than pain is a feeling of constriction, of tightness in the chest behind the breastbone, which may be experienced by those of middle age. It is especially noticeable after a full meal, after smoking or during exertion. This is another of Nature's quiet warnings. It usually accompanies high blood pressure, with or without hardening of the arteries. The more often the sensation recurs, and the more easily it is induced, the more attention it demands.

Symptoms which seem to indicate heart trouble are always alarming. No one else is quite so introspective and morbid as one who thinks there is something wrong with his heart. For this reason palpitation often causes great anxiety.

Palpitation may be caused by grave organic heart conditions, but more often it rises from disturbances not in the heart at all. The sensation may be that of fluttering, a vague consciousness of rapid heart action; there may be a pounding in the chest; or one may be conscious of a sudden stop, followed after a short interval by an emphatic thump. There are all degrees of severity from these rather mild manifestations to a wild racing of the heart accompanied by a sense of suffocation and a fear of impending death. And yet all forms, even the most severe, may be caused in the healthy heart by indigestion, by tobacco, by anything which disturbs the heart nerves through their branches which supply other organs. Emotions also effect the heart centers in the brain. Sudden shock or a highly

nervous state from any cause may set the heart to beating rapidly and irregularly.

But if the attacks of palpitation are frequent and severe the heart should be examined to eliminate the possibility of organic disease. Even the presence of organic heart disease need not be unduly alarming. The heart has a vast amount of reserve force, which enables it to perform its ordinary work in spite of a handicap. The important thing to know is how much one can do without further crippling it. If a breakdown has occurred or is imminent other symptoms are usually present to give warning, especially shortness of breath entirely out of proportion to the amount of exertion which produces it.

Shortness of breath itself, however, is a symptom no more positive or definite than palpitation or any of those so far enumerated. Everyone experiences it at times. Breathlessness is a sign of the desire for more air. It may occur in varying degrees of severity, and each has a different meaning. A fat man has less wind than a thin man, though both may be in good health, chiefly because he has more weight to carry. An athlete can run better when his stomach is empty than when it is full. As a rule men can run farther without exhaustion than women, not only because they are more muscular but because women for generations wore tighter clothing, and they breathe mostly with the upper half of the lungs, while men expand the whole chest in respiration.

Any condition which lessens lung capacity increases the rate of the respirations. But air must come into contact with the blood to fulfill its purpose, and the blood must circulate freely in the lungs. The greater the exertion the more need of speedy aëration of the

blood, and consequently the greater the necessity for increased heart action.

If the heart muscle is weak exactly the same phenomenon of breathlessness occurs that appears when the lung capacity is lessened or for any other reason the air supply is not sufficient. One may smother to death if he cannot get enough air into his lungs, and also when there is plenty of air but the blood cannot get to it.

Breathlessness being a relative condition rising from various sources, let us see what it may mean in various degrees of severity. When it appears during great exertion it is perfectly normal. But great exertion is also relative. To one in physical training it has a different significance from what it has to one of sedentary habits. In this case its onset, early or late, depends entirely upon one's muscular strength.

If it comes on during moderate exertion it may also be due to weak muscles in the otherwise normal person, or after an acute disease which has consumed one's vitality. To such a person, when a call comes to use his muscles they become quickly exhausted, including the heart muscle itself.

The very fat are breathless not only because they are heavier but because great layers of fat accumulate about the heart and impede its movements. But thin people, as well as the fat, can be short-winded from another cause—digestive disturbances. Both indigestion and overeating produce poisons which disturb the respiratory centers in the brain. The result is usually a rise of blood pressure.

High blood pressure and arteriosclerosis may jointly produce the next step in breathlessness—that upon very slight exertion. If one cannot walk upon a

level, or even talk consecutively, without puffing respiration, it may indicate that something serious is wrong with his circulation, either with the heart muscle or with the arteries.

If the trouble is in the heart the muscle itself is at fault. Such a condition cannot be due solely to valvular disease. One may have a leaking valve without experiencing the slightest symptoms if the heart is strong enough to do its work in spite of the handicap. It is only when the muscle gives way under unusual strain, or becomes diseased from other cause, that a valve leak is significant.

Anything which greatly lessens the capacity of the lungs or impedes the inflow of air will cause extreme shortness of breath. It is present in acute pneumonia and in advance cases of pulmonary tuberculosis, because in each a considerable portion of the lungs is put out of commission and the unaffected parts have to do all the work. This fact, together with the poisons always manufactured during the progress of germ diseases, causes panting respiration.

Chronic bronchitis, for a different reason, may be another cause. In this disease the bronchial tubes are chronically thickened and the smaller bronchioles become almost entirely closed, so that the air cells are always full of used air and great effort is required to expel it. This mechanically results in dilatation of the air cells, a condition known as emphysema. Emphysematous persons are chronically short of breath.

There are two forms of breathing which, because they indicate extremely grave conditions, need only be mentioned here. One is continued labored breathing, even when one is at rest, but much aggravated by slight exertion. The other is the inability to hold the breath

even for a moment. They are exaggerated signs of air hunger and indicate serious heart weakness.

If one is comparatively breathless, first let him look to his general physical health—whether he is eating too much, whether he is getting enough exercise. What about his habits as to smoking, as to work and play? Does he sit all day in a stuffy room and then go home to a big dinner, a fat cigar and an easy chair? If his shortness of wind is becoming quite noticeable, to himself at least, he would better find out whether he has an organic disease of the heart, vessels or lungs. Then if these possibilities are eliminated let him look to his habits of diet, of indolence, of self-indulgence, and get rid of them by substituting good habits in their stead.

In the list of symptoms used as a text for this article not the least important is the last—"Are you nervous and despondent?" Nervous in the sense implied means apprehensive, worried, fidgety, fussy, easily disturbed, irritable, irascible, given to magnifying troubles and looking upon the dark side of things, hypercritical, pessimistic, introspective. If one is nervous according to this definition of the word, then of course he is also despondent.

Nearly every abnormal state of the body tends to make one nervous, but in by far the greatest number of instances nervousness is the cause and the physical conditions are the effects. Remembering the various attributes enumerated under the general term "nervous," let us see how they can affect the physical health. In order to be explicit and merely for purposes of illustration, without the slightest intention of limiting ourselves to age or sex, let us take as an example the average business man.

Anyone who desires to substitute feminine for masculine here may—with a few slight changes in the text—make it apply to the woman at home as well as to the man in the office.

This man has a nervous temperament. That is, he is what his friends calls a fusser—those who work for him use other and stronger terms. He worries easily and often without sufficient cause. Business in the office goes wrong because the office clerks are inefficient, and they are inefficient largely because he is impatient and hypercritical. When he goes home he takes his worries with him, never forgetting them for a moment, even while eating his hasty dinner.

Eating too fast, he eats too much. Now too much means no particular quantity, but any amount more than is required or can be taken care of. Unpleasant emotions retard digestion, consequently in his irritable mood any food at all is too much.

The result in a single instance would be acute indigestion. But multiply this by three hundred and sixty-five, and then again by the number of years it has been going on.

Toward middle life this man will have chronic digestive troubles, possibly liver changes and probably kidney complications. His blood pressure will be abnormally high and his artery walls will be harder, less elastic than they should be. In other words, he will be prematurely aged.

During this aging process he may have any of the symptoms mentioned here, and many more—muscle pains in the back, the chest; nerve pains anywhere in the body; shortness of breath, palpitation, vertigo. One might go on through the list indefinitely, but this article is intended to be suggestive and not exhaustive.

The acute illnesses must not be left out of the reckoning, because anything which weakens the vital forces breaks down one's natural immunity to the various germ diseases. Why does pneumonia cause more devastation among the ranks of those beyond middle life? Not because there is an inherent affinity between that disease and age. Younger people are susceptible also, but they have a better chance of recovery. All the help of all the organs of the body combined is necessary to overcome it, and that person has the best chance whose forces are unimpaired.

The chronic alcoholic has the least chance of all, because years of dissipation have produced degenerative changes in many of his vital organs—the kidneys, the liver, the heart and vessels. But mental dissipation also will cause these changes, and this kind of self-indulgence should receive more consideration.

Subjective symptoms, unpleasant sensations, are a blessing and not a curse if they are treated with respect. If they did not appear to warn us we should rush headlong upon our misguided course—to disaster. They should be discussed. Discuss them with yourself. Try to discover what they mean, what you are doing that is wrong and stop doing it; what correctible defect you have and correct it. If you cannot succeed by this method discuss them with one who is competent to discover their cause.

But you cannot hand them over to the doctor as some parents place their children in schools, hoping thereby to absolve themselves of all further responsibility. They are your symptoms and you must have an active part in their correction.

Above all, do not discuss them indiscriminately, because symptoms are catching.

EIGHT

ONE THOUSAND DIAMETERS

WHEN Johnny Smith came home one day with his foot cut—he had been running barefoot—Mrs. Smith knew exactly what to do. She washed it thoroughly with soap and water, carefully cleansed the wound of dirt, applied tincture of iodine to it and bound it up with a first-aid dressing. Nothing remarkable about that. Any other sensible woman, especially anyone who has taken Red Cross work, would have done the same thing. But when Mrs. Smith was a child her mother would not have treated an injury in that manner.

Though Mrs. Smith is less than forty, in her childhood they applied flaxseed and bacon rind and other kinds of vegetable or animal poultices to open wounds. And then when pus appeared, as it almost inevitably did, it was called laudable or praiseworthy.

This difference in the treatment of so slight an injury as Johnny's cut is indicative of all the wonderful changes that have occurred in forty years in both medicine and surgery. Forty years ago operation wounds were almost never entirely closed. There was always a drain left in to allow the exit of the inevitable pus. And just as pus was once inevitable but is now considered unnecessary, so it is with many of the diseases that for centuries afflicted mankind. Many of these diseases have become only reminiscences—episodes of

history. They no longer appear and fatten and flourish at our expense.

And all these changes have been brought about by one thousand diameters. In other words, it was the perfection of the compound microscope that enabled men to see the minute structure of the body, and by magnifying at least one thousand times, or diameters, to bring within their vision the germ enemies of mankind.

The advances in medical knowledge, though less spectacular, have been as great as those in surgery. Perhaps the most obvious instance of our progress in medicine is the change in our attitude toward malaria. Anyone who has lived in a flat marshy district can recall the sallowness of the older inhabitants. In their early days malaria—chills and fever—was so common an affliction that it was looked upon as a necessity. The drug stores could hardly keep stocked with quinine and calomel. Quinine and whisky went together in people's minds—and into their stomachs also, just like hot cakes and molasses. In fact, many a man met an untimely end because he tried to omit the quinine from the combination.

But how many of the later generation have that yellow look? No one before the year 1899 knew that the parasites of malaria attacked people from airships—that is, a certain kind of mosquito. Nor did anyone think of oil as a means of prevention. And yet oil, spread upon the breeding places of mosquitoes, has made malaria a thing of the past.

Malaria has been a great scourge of humanity. It has numbered millions among its victims. It has destroyed nations and submerged civilizations. History tells us that the downfall of Greece was due to the

attacks of invading barbarians upon a decadent people. But their decadence resulted from an earlier invasion. There had always been marshes and mosquitoes in Greece. In the fifth century B. C. malaria was introduced into the country, and the mosquitoes did the rest. When the barbarian hordes appeared they found the Greeks ripe for the harvest.

The same thing occurred in Rome, but there another disease aided malaria in bringing down the mightiest empire the world had ever seen. It was called the plague, but history is vague as to whether it was smallpox or an epidemic dysentery. Whatever it was, together they wrought the destruction of Rome.

Hannibal brought over from Africa his Carthagenian mercenaries to conquer Rome. He did not accomplish his purpose, but the malaria that his soldiers brought with them finally destroyed the health of the people and made conquest easy for the Goths and Vandals.

Physical deterioration of a people is always followed by mental and moral decay. Wherever in history one comes upon a healthy people, there one finds a people of high intellectual and moral standards. During the centuries that the Moors were in Spain they bore the flag of civilization. When they were compelled to go back to the debilitating climate of Africa their moral and intellectual recession began.

Once malaria won a great victory for Napoleon. In 1809 an expedition set out from Great Britain to capture Antwerp and the French fleet. There was quite a formidable array of ships and soldiers, four hundred and seventy vessels and forty-four thousand men, and there was great anxiety in France. Napoleon, however, knew more about the country than the British,

and he counted upon the aid of an ally of which the British were entirely ignorant. He ordered his generals to hold the enemy in check, but not to engage them in a decisive battle. And so the British were held for many days in the swampy region of the River Scheldt. There an ally of the French attacked them from the air. Mosquitoes inoculated them with malaria and the British casualties from this cause alone, in dead and sick, were twenty-seven thousand.

The British expedition was defeated before it could engage the forces of Napoleon. The *anopheles* mosquito had caused more destruction to the British than Napoleon's army could have done. But no one at that time, nor for many years after, knew the part the mosquito played in the campaign. In fact, until 1880 no one had known the cause of malaria, and the mosquito's nefarious business was not discovered until nine years later.

For that matter, it is the same with other diseases. Typhus fever, the bubonic plague, smallpox, tuberculosis—one could go through a whole list—all were known to the ancients; that is, their effects were known and the fact that they are transmissible, but there all knowledge stopped.

Nearly all important discoveries of the causes, modes of transmission and means of prevention have been made within the past forty years. All those previous centuries men were helpless against these foes because they could not see them. They were fighting in the dark. And so concerning the things of which they were ignorant they built up superstitions, and doctors cloaked their ignorance with mystery and mysticism. About all there is left of that is our prescription Latin. But the mystery helped some, because it inspired Faith

and her handmaiden, Hope, which are more potent than all the horrible concoctions of the ancients.

With the exception of anatomy and physiology, the medicine of a little more than one hundred years ago was about the same as that of five hundred years B. C. All medical knowledge for centuries was at a standstill. If one were to compare the prescriptions in the Papyrus Ebers, which was written 3500 years ago, with those in medical books of the eighteenth century, he would discover striking similarities. This is because there was no knowledge of the causes of disease until the invention of the microscope, and medicine was lost in the fog of ignorance and superstition.

Suppose Johnny Smith, whose mother treated his cut so sensibly, had lived in the Middle Ages or at any period up to, say, fifty or a hundred years ago. His mother would have sent off posthaste for the nearest surgeon, or leech, as he was once called. In the meantime she would have given Johnny three, five or perhaps ten grains of calomel and a dose of oil and would have applied hot vegetable or animal poultices. And then the leech would have appeared, armed with a lancet and another kind of leeches. He would have bled him generously, perhaps more than once, and the leeches would have drained him still more.

From a book published in 1745 here is the cold-blooded narrative of a licensed assassin as quoted by Mark Twain. The subject, or patient, had a headache, that is all:

"I, being called, Order'd Venesection in the Arms, the Application of Leeches to the Vessels of his Nostrils, Forehead and Temples, as also to those Behind his Ears; and likewise Prescrib'd the Applica-

tion of Cupping-Glasses with Scarification, to his Back; But Notwithstanding these Precautions, he dy'd. If any Surgeon, Skilled in Arteriotomy had been Present, I should have Order'd that Operation.

Leeches, venesection, arteriotomy—all for the purpose of separating the victim from his blood! If Johnny's mother should read this she will be thankful that she lives in the present and not in the past era of medicine, or "notwithstanding," Johnny might have "dy'd."

For centuries roots and herbs were prescribed because of their symbolic forms, and diseases were banished by incantations. If Johnny had lived in the seventeenth century and had chanced to have the whooping cough his mother could have found in a standard medical work the folowing information—archaic spelling omitted:

"For whooping cough, pass the child nine times over and under a donkey, from left to right."

Mrs. Smith might have wondered what would happen if she got in reverse and passed Johnny from right to left. But she would not have chanced it—not in those days.

While waiting for someone to produce a docile donkey that would consent to cure Johnny, perhaps Mrs. Smith idly turned the pages of the medical work. If she did she would have been interested in this:

"It is said that many have been cured of the falling evil by drinking of the powder of dead men's skulles, burnt."

The author did not say how one can drink a powder,

but he was very particular to mention the kind of a "skulle" that should be used.

"But the skulle must be the skulle of one that hath been hanged or slain, and not of one that hath died of any sickness."

One can imagine the medical student of those days, fired with a burning enthusiasm, yet shivering from fear, stealing out on a dark, stormy night to obtain the "skulle" of the latest victim of the crossroads gibbet. They were considerate enough to hang men —and women, too—at the crossroads, which made it easier for the doctors.

Spiders were good for malaria. If you have had any doubt in your mind as to what spiders are good for, now you know. Most people think spiders are good for eating flies and that flies are good for feeding spiders, but here is a use that perhaps you did not suspect. They are good for malaria. Just how they were taken, whether "drunke" or swallowed whole, was not mentioned, but you may depend upon it, whatever was particularly loathsome was good for something.

"A good pouder for the jaundice is as follows: Take earthworms and cut them small and braye them with a little wyne so that ye may swallow it; drinke the same fasting."

The last direction must have been a mistake. It should have been: "Drink the same fast!" It is possible that the doctor himself did the "braying."

And then there were snails. Fine ladies had their footmen gather snails in the garden before breakfast. It had to be before breakfast; after breakfast would

not have done. These snails were pounded, shells and all: "To be swallowed for a consumption."

Disease was thought to be a thing, an entity, something that entered into the body and must be driven out by a remedy stronger than itself. Perhaps this idea had something to do with the size of the prescriptions. Some of them contained more than one hundred ingredients. They were built up by succeeding generations of doctors. Each doctor had to add one drug or more as his contribution to medicine or realize that his life had been wasted. After worrying about it for years, possibly, one day he would exclaim: "Gadzooks," or "I, faith," or "By my halidome, I've got it!" Then he would put into the prescription something more terrible and loathsome than all the rest, and having done so, when his time came he would pass the mess on to his successor before he himself passed on, content that his life had been well spent.

Those were fat days for the druggist. In 1676 Dr. Gideon Harvey, physician in ordinary to Charles II, wrote:

"I have oft seen bills of Apothecaries risen to twenty pounds and sometimes thirty pounds in the time of a fortnight. Not long since an Apothecary of our suburbs brought in bills to nine patients for less than three-quarters of a year's physick amounting to fifteen hundred pounds."

That would have been equivalent in purchasing power to about forty thousand dollars at the present day! All of which goes to prove that compared with his ancient prototype the modern druggist is a piker.

And then there was blistering, a favorite method of torture. It was probably the first crude experiment in

New Thought treatment. It took the patient's mind off his other troubles. Being so occupied with the new sensation he had no room for the old ones. Sometimes the desperate victim refused.

"You must be blistered or you will die!" said her physician to the Duchess of Marlborough.

"I won't be blistered and I won't die!" said the strong-minded old Sarah, and she kept her word for many years.

Scrofula was called king's evil and was cured by the touch of the king. For hundreds, perhaps thousands of years people had clung to this belief, which was probably fostered by monarchs to strengthen their claims to divine right. Dr. Samuel Johnson was touched by Royalty at the age of four, but it did not rid him of his taint. Between May, 1662, and April, 1682, or twenty years, Charles II touched ninety-two thousand one hundred and seventy persons. One day a week, Friday, was given over to this touching ceremony, so he must have averaged a little more than eighty-eight persons at one sitting. On some Fridays, when it was necessary to make up for lost time, he exceeded the speed limit, touching more than two hundred and fifty victims of scrofula. But he himself was touched also, for it was the custom to give to each a small piece of gold, called the "touch coin."

Another favorite was bleeding. This was the first, the middle and the last resort. If the doctor did not know what ailed one—and mostly he did not—he bled him. If he did know he bled him anyhow. A consultation resulted in more bleeding. Either the lancet or leeches were used, most probably both—and often.

Louis XIV was bled generously nine times for scarlet fever. In 1765 a London mob attacked the

Duke of Bedford's house. This probably caused the duchess to have an hysterical fit, for the next morning the doctors bled her. George Selwyn was dining one night at the home of Lord Coventry and fell, striking his head upon a marble table, causing a wound which bled profusely. When the surgeon came did he lay George down, cleanse and dress his lacerated wound? No, that would have been too simple and obvious a method for those days. He bled him, though Nature was doing the same thing herself!

Ambroise Paré was a celebrated surgeon of his time —earnest, painstaking and indefatigable in his search for truth. But truth held her face averted. Paré having heard that an Italian surgeon had a wonderful dressing for wounds determined to get the secret. He gave up his practice, left his home and served a two-years' apprenticeship with the Italian. He says: "In the end, thanks to my gifts and my presents, he gave it to me. Then was I joyful and my heart made glad that I had learned his remedy."

Triumphantly, his soul filled with high enthusiasm, he took it back home with him and no doubt used it upon wounds thereafter for the rest of his life. This marvelous remedy, to learn which he had served two years and given presents and gifts, might have been used upon Johnny's foot if he had lived in those days. It was composed of "Young puppies, boiled in oil of lilies, and earthworms prepared with Venice turpentine."

But most probably the attending surgeon would have used a "sympathetic" powder. A sympathetic remedy is one that heals by sympathy. That is, it does not come into contact with the wound at all. One removes the bandages that have been applied as a first-aid dress-

ing and dusts them with the sympathetic powder, then lays them away in a corner cupboard and the wound begins at once to heal.

You don't believe it? They believed it in the seventeenth century, as the following narrative will attest: In 1687 a certain knight attempted to stop a duel by stepping in between two adversaries. Like many another well-meaning go-between before and since he got the worst of it, of course, receiving a serious sword wound in his leg. Then he promply sought the attention of a surgeon, who treated him for some time without accomplishing anything. In fact, under the treatment the knight grew so much worse that he began to fear for his life; also he began to think that he was not getting the right treatment. So he paid off and discharged this surgeon and called in another.

Under the treatment used by this second surgeon the wound began to heal and eventually our knight became entirely well. But when the second surgeon presented his bill for the treatment the knight refused to pay him, though he had paid without question the bill of the first surgeon, who had not benefited him. Naturally, the second surgeon entered suit to recover his fee. And we should be grateful to the knight for his obstinacy, because the records of this trial—and especially the judge's charge to the jury—give us a most interesting account of the medical knowledge of that day.

The judge was one Sir Thomas Street, Knight, Justice of the Common Pleas Bench. If Sir Thomas never did anything else in his life, he made his fame immortal by his charge to the jury in this case. In those days a physician's calling was too honorable for him to receive a fee for his services. He could accept an honorarium, which was whatever the donor wished

to give, but never a fee. He could not sue, even if the patient refused to pay anything. But a surgeon's calling was lower than that of a physician, consequently the judge decided in the beginning of the trial that the surgeon was entitled to sue. There is nothing further in the records to show that our surgeon had a single other decision in his favor.

This being settled to the satisfaction of the plaintiff, the case proceeded. All the evidence having been presented on both sides and the attorneys for both plaintiff and defendant having delivered their addresses, the judge charged the jury. Reviewing the facts as established, he recited that the knight had been attended by the first surgeon, who used one of two approved methods of treatment. That is, approved by the medical profession of that day, which of course established them as "the usual and ordinary practice," according to legal terms. Not improving, the knight had dismissed the first surgeon and hired another one, "expecting to be treated by the second method."

Sir Thomas goes quite fully into both methods of treatment, but the second method is interesting, because it is difficult to believe that anyone could have had faith in it in any age. I quote the judge:

"It is of Roman vitriol, powdered and dried in the sun, and is not applied to the wound at all. The surgeon procureth a garter or bandage with which the wound was first bound up, and sprinkleth the powder upon the blood which is upon the garter or bandage. And the patient thereupon feels an intolerable shooting and penetrating torment; but this soon vanisheth—thenceforth all previous evil symptoms depart; the part recovereth its original lively color and manifest

incarnation and consolidation ensue. This is by reason of the sympathy maintained betwixt the blood extravasated and that yet conserved in the veins and of the sovereign balsamic faculty of the vitriol. This is not applied to the wound, but is allowed to have its perfect work apart. The garter is laid away in a cool place."

There you are, simple and rational. We have the authority of Judge Street for it that it is also effective. But the ignorant, obstinate surgeon would have none of it, though all his professional brethren sanctioned and approved it.

"Now the plaintiff did naught save wash and tend the wound. He used no sympathetic powder or ointment."

No, he said that there was no such thing as a "magnetical remedy"—in spite of his medical brethren. He said that Nature would do the work herself if she were let alone and the wound merely kept clean. But he put himself far beyond the pale of the profession when by pure reasoning he forecast the germ theory. Again, our judge:

"He even hath in his mind some crochet that pus is engendered by some animal or plant; some bug or grub or beetle or fungus belike, though he saith he cannot prove the existence of such creatures."

Sir Thomas was facetious there; a bit sarcastic. One can imagine the smiles and smirks on the faces of the court attendants and the jury. But now his brow darkens and in sympathy the features of all the jurymen and the tipstaves grow hard and stern:

"It might be well for the plaintiff to take heed, lest he be condemned by the Holy Church!"

Guilty not only of medical iconoclasm but of religious heresy. Of course the decision was for the defendant. The judge said the surgeon did not deserve a fee anyhow, because by his own admission Nature had done the healing, and consequently Nature —not the doctor—should have the credit.

The most interesting part of this record is that a surgeon in 1687 should have had a germ theory of his own invention, though germs were not discovered until after the middle of the nineteenth century.

Doctors were no more ignorant than those who pursued knowledge by other paths. If in the seventeenth century the liver was supposed to be the seat of anger, the spleen the home of envy and the heart the habitat of love and courage, other scientists believed in the transmutability of metals, in the elixir of life, in astrology, in magic and witchcraft. One year before the founding of Harvard College, or in 1635, a scientific work was published in which gold was asserted to be a combination of quick-silver and sulphur.

The Witch Statutes of the English Penal Code, which were enacted during the reign of Henry VIII in 1542, were not repealed until 1736. Mackey, in his memoirs of Extraordinary Popular Delusions, estimates that in Europe during the seventeenth century more than forty thousand persons were condemned and burned at the stake for witchcraft.

The advance of knowledge was retarded not only by the lack of scientific instruments, but very largely because of the haphazard, speculative methods of that day. This is well shown by the following anecdote:

Once King Charles II asked his courtiers "whether a

vessel full of water weighs more if a fish is put into it."

This profound question started long and heated arguments lasting weeks. Finally it was decided that a live fish would not increase the weight, but that a dead fish would. This conclusion was reached by the path of speculation. A long time afterward it occurred to someone to find out by putting a fish into a bowl full of water. That was the path of experiment.

The occasional genius who had the temerity to contradict the fathers of medicine met with very little encouragement. Tradition died hard and truth had a difficult time of it.

The great friar, Roger Bacon, is said to have invented spectacles and to have constructed microscopes and telescopes. He was rewarded by ten years' imprisonment.

Vesalius, the great anatomist, was twenty-eight years old when, after laboring five years, he published his book, The Structure of the Human Body. But he had dared to contradict Galen and he brought down upon his head a storm of indignant protest. In disgust and disappointment he destroyed all his unfinished manuscripts, gave up his studies and left Italy, never to return.

Harvey published his discovery of the circulation of the blood in 1628 and the result was a cataclysm of abuse and ridicule. Medicine was still struggling blindly in the fog of metaphysics. Haller, an eighteenth century scientist, says in his book on Physiology: "Our body is gradually built up of gelatinous or slimy fluid." And of such "gelatinous and slimy" materials were the theories of medicine built up.

"Up to the year 1830," says Oliver Wendell Holmes, "Nature had kept over all her inner work

shops the forbidding inscription, 'No Admittance!' "

It was in that year that the compound microscope was perfected. Then men began to see for the first time the minute structure of the body and that we are all commonwealths of cells of various kinds and functions.

Virchow, in 1858, went further still. He proved that all forms of life, whether animal or vegetable, are made up of cells. Think of it! Whether germs or Germans, parsnips or potentates, all are single cells or bundles of cells.

The microscope has revealed much more than the minute structure of our bodies. It has given us the germ theory—which is a theory no longer—of the origin of many diseases.

It has disclosed the warfare that is waged continuously within us in the struggle for existence. Now and then in the past a visionary like our surgeon of the seventeenth century hazarded a guess. But until the past four decades each was forced to say with him that he "could not prove the existence of such creatures." Now for the first time in all the centuries we can see our foes, and seeing, we know what weapons to use against them.

Most disease germs belong to the lowest orders of vegetable life. They are infinitesimal, and yet they possess all the properties of the vegetable kingdom.

Being fungi, they grow under the same conditions as others of this group of plants. Needing a soil, they thrive best in poor soil, and their soil is animal tissues broken down by previous illness or any of the many conditions that lessen the resisting power of the body.

In the blood stream float little protoplasmic bodies called white corpuscles, which resemble the gelatinous

form of animal life—the amœba that floats in stagnant water. Like the amœba, the white corpuscles have a peculiar power of locomotion which is achieved by projecting a small part of their bodies and gradually pulling the rest after it. They can penetrate the walls of the smallest blood vessels, the capillaries, and wherever there is trouble there they congregate in great numbers, because they constitute the army of defense. Between them and disease germs, or bacteria, is waged the ages-old war for supremacy.

Bacteria enter the body by one channel or another, get into the lymph stream, or the blood, and finally into the tissues; or they may gain entrance directly as the result of injury. Their presence sets up an irritation and the intelligence is flashed to the nearest headquarters. At once the local blood stream becomes congested and battalions of the defensive army hasten forth.

What really happened when Johnny cut his foot? It is all an open book now, because the microscope has revealed it many times. Four things occurred in rapid succession—redness, swelling, heat and pain. This combination of events is called inflammation and is usually regarded as a sinister process, though it is really the result of Nature's attempt to guard us against destruction.

Here is the sequence: The injury caused an irritation of the nerves of sensation and they communicated with the nearest nerve substations. From these word went out to send immediate assistance to the frontier. Then the streams that transported the army of defense became engorged, more blood was rushed forward and with it the troops—the white corpuscles. As they approached the spot they left the main current and

adhered to the capillary walls. Then gradually they penetrated the walls by that curious power of locomotion which they have and assembled in battle array to repel the invaders.

The redness, swelling and heat then were caused by dilation of the capillaries, exudation of blood and corpuscles into a confined space. The pain was the result of the original injury to the nerves and of the pressure upon them in the swollen tissues.

Wherever an injury occurs to the body, whether there is an invasion of germs or not, the same defensive mechanism is set up. Pain, however, is not so constant or so severe in the interior as upon the surface, because the frontiers are crowded with sensitive sentinels—the nerves of sensation. These may be entirely absent from the inner citadels.

But dirt was introduced into the wound and with it certain bacteria. Johnny's mother removed all she could by scrubbing and she applied a mild antiseptic to destroy the rest, but obviously she could not destroy them all. The remainder must be attacked by Johnny's defensive army. This fight is called phagocytosis.

In such a fight the home-defense soldiers engage in single combat like the knights of old. Meeting a germ enemy, the corpuscle enfolds it just as the amœba surrounds its food and a struggle begins. If the corpuscle is the stronger, the germ is destroyed and digested. But if the latter is especially virulent or our champion weakened by one cause or another, victory goes to the enemy. The germ then begins to subdivide, increasing in numbers until finally the corpuscle disintegrates.

Multiply these single combats, which the microscope has enabled us to witness, by hundreds of thousands and you may understand the battles royal that occur

in our bodies when our army is called upon to defend us.

With some of the myriad forms of bacteria we rarely come in contact; with some we are frequently in conflict; and others—like the poor—are always with us. The fact that we have survived implies that we have within us a resisting power that has given us innumerable victories. This resisting power or immunity may readily be broken down by improper living, worry, overwork, undernourishment, insanitary surroundings; by dissipation of any sort, whether mental or physical. When our immunity is weakened the white corpuscles have an unequal fight and the processes of disease make inroads upon our health.

This knowledge of the causes of infectious diseases has enabled us to bring another weapon of defense to bear upon them, because we have learned also their methods of transmission. This weapon is prevention.

Until 1880 malaria was supposed to be caused by a miasma, a vapor rising from swampy ground after sunset. But in that year a French physician, Laveran, found the germ, a low form of animal parasite. But the cause of its transmission, the anopheles mosquito, was not discovered until years after. Also the transmitting agent of yellow fever was found to be another kind of mosquito. Since these discoveries destructive campaigns against mosquitoes have gone forward and mankind is free.

One of the plagues sent down upon Pharaoh as a punishment is supposed to have been bubonic plague. It has always ravaged Asia and at times it has swept over Europe. A peculiarity of this disease was noted as far back as Herodotus. An outbreak was always preceded by a similar epidemic among rats.

Not until the year 1890 was the cause found, the *bacillus pestis*, a small rod-shaped vegetable germ. But harder still to discover was the connection between the rats and the plague. This is the sequence of it: The rat has his own kind of flea. If the rat has the plague the fleas become the temporary hosts of the germ. After the rat dies his body becomes too cold to be a habitat for the fleas and they seek other scenes and pastures new, sometimes human bodies. The germs of plague are so virulent that it is only necessary to crush an infected rat flea against one's body to acquire the plague. And this—to paraphrase a celebrated classic—is the sequence of the transmission:

This is the germ of bubonic plague.

This is the rat that had the germ of bubonic plague.

This is the flea that bit the rat that had the germ of bubonic plague.

This is the man who got the flea that bit the rat that had the germ of bubonic plague.

Simple enough now to exterminate the plague by destroying rats!

One by one the lurking places of disease have been disclosed and their strongholds stormed and taken.

For us bubonic plague and typhus fever have merely historic interest. Even smallpox has lost its destructive power. There are thousands of doctors in the United States who have never seen a case. Typhoid fever—thanks to sanitary measures and to the use of typhoid vaccine—has ceased to be the menace that it once was. The mortality from diphtheria is rapidly reaching the vanishing point. And so one might go on enumerating the former enemies of mankind that have been vanquished—until one comes to tuberculosis.

Will tuberculosis ever be stamped out? That depends. The difficulty is greater because the common carrier of the germ is man himself. He cannot be destroyed like rats and mosquitoes, so he must be taught. But with this disease, more perhaps than with any other, there is one mitigating fact. Everyone, almost everyone, has been in conflict with the bacillus tuberculosis. Having survived to adult life, he has repelled—or his defensive forces have repelled for him—many times the onslaughts of the enemy, and by his victories he has acquired an immunity that must be broken down before he is vulnerable. The breach in one's defense may be caused by other disease through no fault of his. But more frequently it may arise from improper living, overwork or dissipation.

And so, due to the microscope, the causes of disease have been discovered and the means of prevention disclosed—and all this within forty years. But the fact which should especially interest all of us is the doctrine of immunity—that we have within us certain defensive forces against these enemies, forces that we can strengthen or weaken as we choose. In many cases the fight will go for us or against us, depending upon what we do.

A whole epistle upon this subject could be condensed into two words: Live right! Not too hard, not too easy; not too fast, not too slow—temperately, moderately, happily.

Bromidic? Surely! But so are all great fundamental truths. Nature is the great preventer, the great restorer—that is, the force within us. In that seventeenth-century trial quoted at considerable length in this article the physician had asserted that Nature had done the healing; that he had only kept the wound

clean. Judge Street remarked with sarcasm but with greater truth than he knew, "Then Nature deserves the credit!"

Very well, give Nature the credit! But give her a chance!

NINE

THE ETERNAL WARFARE

IN order to prevent the slightest misunderstanding it must be said at once that this chapter has nothing to do with the late unpleasantness in Europe, nor with any conflict or succession of conflicts between nationalities or individuals of the human race. It will concern itself with the never-ending fight for supremacy between plants and animals, and the bearing it has upon our daily peace, health and happiness.

Even that is too big a subject for a limited space, and there will be no attempt to cover it. Merely a cross section, a single instance, of the warfare will be described, using common conditions as an example. And of the many enemies of mankind, a single foe, or rather family of foes, will be chosen.

Plants live upon animal matter, either living or dead animals; and animals could not exist without the vegetable kingdom. Even strictly carnivorous animals must eat flesh that has been nourished by plant life. One essential element of all life is nitrogen, which must be obtained from the air. Plants alone have the mechanism by which living nitrogenous compounds can be manufactured. And so all animal life must get them secondhand, from plants or from other animals that have obtained them from the vegetable kingdom.

Most plants require that animal tissue shall have undergone disintegration before it can be appropriated as nourishment. But decay is accomplished by other

plant life, the infinitesimally small bacteria of putrefaction which attack all dead matter of either kingdom. There are notable exceptions to this rule, but they are few as compared with the others. The pitcher plant, for instance, captures its food alive and digests it. But, whether alive or dead, animals are the natural prey of plants, and plants of animals. This conflict has gone on unceasingly from the time of the separation of organic matter into the two great divisions. And it will continue as long as both exist.

Most bacteria are small vegetable organisms of simple structure, belonging to the lowest orders of organic life. Like members of the higher orders, they require food upon which to thrive. And also like them, some live upon dead tissue and others upon the living.

The latter are the germs which by their growth in the body cause most of the acute infections. If it were not for the fact that the very vast majority of such conflicts have resulted in victory for the animal kingdom these small but exceedingly virulent enemies would long ago have annihilated it.

Mankind is continuously besieged by disease bacteria, and yet comparatively few succumb. Why is it that so many are called and so few chosen? Because everyone is possessed of fighting forces which enable him to combat his bacterial enemies. Depending upon whether these defensive forces are potent or impotent will the issue be either victory or defeat.

In all infections two elements must be present—first, the germs; and second, conditions favorable to their growth. By favorable conditions it is implied that the bacteria must overwhelm by their numbers or virulence, or that the natural resistance to them is

lessened. Many billions of bacteria in contact with the human body do not constitute an infection, unless they continue to grow and multiply and throw off their poisons, and cause destruction.

The living body may be likened to a citadel surrounded by enemies. They attack from every direction; they are present in the atmosphere, in the dust that collects on the surface of every object touched. Always there is skirmishing with some of the commoner varieties of the foe, and sometimes they overwhelm by their numbers and strength. But as long as the outer walls remain intact, the battlements manned with defenders, just so long will the citadel be safe.

It will eventually succumb to age or it may be weakened by internal causes. But if it be strongly guarded and wisely governed, and if the enemy does not attack in too great numbers, the siege will last the allotted time, until the hour strikes when each human citadel must fall, due to failure of the forces within.

The defenses of the body are of two kinds, outer and inner. On the principle that it is better to keep a foe out than risk an encounter after he has gained a foothold, the outer defenses are very strong. They are the skin, which covers the body, and the mucous membranes, which line all the inner passages communicating with the outside.

The mucous membrane is one of the primary defenses because it also is an outer lining of the body. Its location is different, that is all. Nothing is really inside the body until it has pierced the outer layers of the skin or the mucous membrane. To illustrate the analogy between the two, push in the finger of a glove, inverting it. The inserted finger of the hand is not within the glove; it is still surrounded by the

outer covering. To get into the glove by this route, that covering must be broken.

And so it is with the body. To get within the body bacteria must penetrate the lining. This is usually accomplished by some force or circumstance other than that within the germs themselves. An injury must make the breach or an unhealthy condition weaken the defense.

The coverings of the body, then, are its outer ramparts, its first defense. They are able to withstand repeated onslaughts without harmful results. The fluids which their glands secrete—sweat, saliva, mucus, gastric juice—either kill germs or disarm them.

But as happens innumerable times to everyone, when this first defense at any point is broken down the enemy gains entrance. Then the secondary defenses are called upon for assistance. Every tissue has this defensive power, some more than others, but not one is without it. All the tissues have one characteristic in common. They are all made of the same basic substance, protoplasm. Every cell, whether of skin or brain, muscle or sinew, mucous membrane or the tiny bodies that float in the blood stream—all are protoplasm. They have many different structures and functions, but they are of one material. And they have a common antipathy toward bacteria. This applies to all germs, to those which cause pus as well as to those which produce the acute infectious diseases, such as pneumonia, influenza and typhoid fever.

There is a very numerous and prolific family of bacteria called streptococci, the various members of which cause pus. Some members of this family are more poisonous than others, but they are all capable of setting up an infection when they achieve a victory.

Once having effected an entrance through Nature's first defenses, either the skin or mucous membrane, an infection will result if the secondary defenses are not strong enough to overpower them.

Suppose two persons receive similar injuries to the hand, produced by the same cause, which has broken the skin surface and introduced as nearly as possible the same number of streptococci beneath the surface. Suppose that the first-aid treatments, the cleansing and the dressings, are exactly the same.

One wound heals promptly with very little discomfort and inconvenience. The other not only fails to heal but the hand becomes swollen and inflamed; pus forms and other disastrous results follow.

By a fortuitous occurrence in each case the enemy finds and gains entrance through a breach in the ordinarily impregnable wall of the citadel. And in each case the secondary defensive forces are called upon to repel him. At once the cells of that whole neighborhood are thrown into a state of the greatest excitement and activity. They begin to secrete fluids, chemical substances, the purpose of which is to weaken the violence of the onslaught and to neutralize the poisons which the bacteria produce. Chemical warfare, then, is the first result.

But without other help the cells would not be able to withstand an attack of the enemy in appreciable numbers. A few bacteria may be overcome, slaughtered, and washed out by the blood flow. Then a blood clot may close the opening and further attacks be prevented. More often, however, the germs begin to attack and kill the nearest cells, throwing off poisons as they proceed about their nefarious business.

These poisons which they create are often their own

undoing. Their presence causes an emergency call for reenforcements. Soon the troops of the garrison, the white blood corpuscles, rush to the rescue. They come on the swollen blood streams and pour out through the torn vessel walls. They are so small that in times of trouble like this they have the power to penetrate between the plates which line the unbroken capillary walls. Because of this ability to go where they are needed, the white corpuscles are called wandering cells.

How do they obtain the word that they are needed, and how are they able to respond so promptly? The presence of the bacteria and their poisons irritates the small nerves which supply the injured part. The message is transmitted along these nerve wires to certain nerve centers, and the answer comes back which dilates the vessels and slows the blood stream. This enables the corpuscles to debark, and with the constant flow of blood through the capillaries more and more troops hasten to the rescue from distant parts.

Then begins an aggressive fight which cannot end for individuals on either side except in victory or defeat; there can be no armistice. In 1883 Metchnikof was observing a small sea animal, the daphnia, under the microscope, and noted that its cells had the power of digesting infinitesimally small yeast plants with which they came in contact. He saw the daphnia cells project a part of their bodies and gradually surround the yeast cells. A little later the latter had disappeared, having become a part of the animal cells.

Here was the story in miniature of the eternal fight for supremacy between plant and animal. Later, when observing the circulation in a frog's foot, he injected into it the germs of tetanus, or lockjaw. Then he saw for the first time in the history of science the

fight between a germ and a white corpuscle. In the same manner, because the white corpuscle is a minute mass of protoplasm, like the daphnia cell, the hosts of the latter consume invading enemies.

To these hand-to-hand encounters he gave the name phagocytosis, and the white corpuscles which fight our battles continuously for us are called phagocytes. It is they, then, that obey the call of distress and come to the rescue when bacteria have penetrated our outer line of defense.

The number of these defenders in normal blood is enormous, but when the streptococcus has gained a foothold within the body another remarkable phenomenon takes place. At once the menaced garrison begins to mobilize more troops, to call to colors a reserve army of white corpuscles. If the need is great this force may increase to more than ten times their usual number in the blood.

Not every kind of bacterial enemy causes an increase in the army of white corpuscles. The germ of influenza, for instance, and the tubercle bacillus, among others, are incapable of inciting this call to arms.

White corpuscles are of several kinds, some of them soldiers and others merely camp followers, having different duties than that of fighting. Both kinds are called by various names, but that common to all is leucocyte, which merely means white body; and their presence in the blood in increased numbers is called a leucocytosis. In order that there may be no confusion of names for white blood corpuscles it must be understood that they are all called leucocytes, but phagocytes are the wandering leucocytes that make up the army.

Pus germs, as has been intimated, invariably cause a leucocytosis. So does the germ of pneumonia. On

this fact depend two conclusions of tremendous importance to the victim of either of these bacteria. In the case of the streptococcic invasion, however obscure and remote the battlefield within the body, microscopic examination of the blood which discloses a leucocytosis helps the physician to determine the nature of the trouble. The body is fighting pus somewhere, and has mobilized additional troops.

Or, if one has pneumonia, the amount of the leucocytosis gives the attending physician an idea of the kind of fight the forces of Nature are putting up, and, within certain limitations, what the issue will be, whether victory for the defenders or rout and defeat.

But, to return to the two similar hand injuries which resulted so differently, why did one wound heal promptly and the other proceed to suppuration?

The difference in the defense is not so much in the white corpuscles themselves as in the tissue cells. Neither the former nor the latter can wage a successful fight alone; they must act reciprocally, each reenforcing the other. In the wound which heals promptly the tissue cells are able to secrete a specific antipoison in sufficient quantity to lessen the deadly activity of the bacteria and to counteract their poisons. In the losing fight, however, these secretions are less powerful. Something is wrong with an essential element of the defense, perhaps due to an inherent weakness in the individual, but often the result of other conditions over which he has more or less control.

Not being properly reënforced by the chemical warfare the wandering cells, the leucocytes, wage an unequal battle against troops whose numbers rapidly increase. It does not take bacteria long to propagate their kind.

The pus germs, not being repulsed at their first onslaught, increase in number and in the violence of their attacks. More and more white corpuscles with reckless bravery hurl themselves upon the enemy, slaying millions, but themselves being finally overcome. Tissue cells are destroyed, and the bodies of slain defenders and enemy alike litter the battleground.

This débris, with the watery constituents of the blood that are poured forth, together constitute that resultant thick fluid which is called pus.

Always aggressive, always fighting, the streptococci soon seek to extend their conquests. In the lymph streams of the skin they travel, desperate skirmishing following their invasion. Now red streaks appear on the arm, marking their progress. Eventually, if not checked, these will reach the shoulder, especially if the pus is dammed up at its source.

The lymphatics of the arm pass through certain small glands in the axilla, the space under the shoulder joint. These substations are placed in various parts of the body for the purpose of filtering out just such invaders as now appear. They check the progress of the enemy host, but themselves become swollen and inflamed, a sacrifice to the cause, being Nature's third line of defense.

If the pus in the hand has not been given free exit by the surgeon's knife it will follow the course of the bacteria, and there will be a general infection of the arm. The axillary glands will soon break down and suppurate. By this time the condition will be extremely dangerous. Great destruction will follow if there is not immediate relief, if all the pus areas are not freely opened and cleaned of débris. For dead germs are

poisonous as well as the living, and both the dead and the living are in the pus.

Another great danger lies in the fact that the bacteria may be carried by the blood streams to distant parts. When this occurs inflammatory processes may appear at any point in the interior. Pus will form in other and obscure places. The blood will be teeming with the enemy and the desperate fighting will be general. The whole citadel will then be threatened, and will need all the help that science can bring to bear. This is the condition known as bacteriæmia.

The skin is much less vulnerable to infection than the mucous membranes. Practically all the bacteria of the acute infectious diseases enter by the latter route. The skin is impervious to most of them. Typhoid fever germs, for example, when rubbed into a broken skin surface will cause only a local irritation, because Nature's secondary defenses there destroy them.

But whether bacteria enter by one route or another, the methods of attack and defense are the same, and the same factors determine the issue. Injury to or an unhealthy condition of the mucous membrane secures the necessary breach in the outer wall, and, that once effected, the tissue cells and the leucocytes must carry on.

The mucous membranes of the nose, mouth and throat are favorite points of attack of the streptococci. The nose is the proper channel through which air should enter the lungs. Streptococci, uncounted numbers of them, are suspended in the impalpable atmospheric dust. The nose is the natural air filter and very few bacteria of any kind get far through the normal nose. There they are collected, with the dust,

and the mucous secretion renders them harmless and washes them away.

But if there are obstructions in the nose or the nasal sinuses, those accessory cavities that are connected by small openings with the nose, an unhealthy condition of the membranes results, and the bacteria find conditions favorable for growth. Then the membranes become congested and swollen, blocking the exits, and pus accumulates. Not only is the first defense broken down but the resistance of the tissue cells is weakened. Here, then, is created a focus of infection, an entrenchment of the enemy, from which he may sally forth at any time to wreak destruction elsewhere.

If the pus pocket can be drained freely and frequently washed out the danger is lessened. Especially if all obstructions to drainage are removed Nature will have a chance to fight her way to victory.

In the back of the mouth, at the portal of the throat, there are several germ filters, the largest of which are the tonsils. They have an important duty to perform, especially in infancy, to protect from infection the child so recently arrived in a hostile and menacing world. But if the tonsils have a greater burden than they can withstand they become diseased. Then they are a menace to health rather than a protection.

Mouth breathing, to which those are compelled to resort who have nasal obstructions, a habitually dust-laden atmosphere, sudden exposures to extremes of cold and heat—these are the most frequent causes of diseased tonsils. They become the depositories, the germinating ground, of bacteria.

Within their pockets, or crypts, the streptococci

collect, thrive and multiply. Pus forms and exudes, to be absorbed elsewhere. And other bacteria find a soil prepared for them, especially those of pneumonia, of influenza and of diphtheria. The tonsils and the nose are the headquarters from which these deadly germs go forth when opportunity offers, to wreak havoc.

Pus germs have another favorite point of attack, the teeth, because the teeth and gums are so frequently neglected and misused. Particles of food which are allowed to collect round the teeth soon undergo decomposition, and the result is an admirable medium for pus germs. Let the gums be irritated by the ferments of putrefaction, their margins detached by rough, unskillful use of the brush, and all the necessary conditions are present for the formation of pus pockets. Pyorrhea may be confined to one tooth or may affect many, but whether single or multiple its effect upon the general health is profound.

Just here it may be well to interpose a word of caution. A few years ago if anyone, doctor or dentist, had advised tooth extraction as a cure for rheumatism or other general bodily ailment it is not difficult to imagine what would have become of his reputation. Now there is none so poor or ignorant as not to do the theory homage. There is no question but that this knowledge may be carried too far. Teeth should not be extracted upon suspicion, or we should soon become a toothless race. If there is the slightest doubt an X-ray picture of a tooth root should establish the charge of guilt before sentence of execution is pronounced.

One who is otherwise in good health can withstand for a long time poisons which are absorbed gradually

and in minute quantities, whether they are produced by bacteria or by any other cause. They are antidoted and cast off by the natural forces of the body. But if the amount becomes greatly increased or the natural resistance is weakened, then the balance of power will be upset.

In the case of the pus pocket in a tonsil or around a tooth, for years the germs may have been entrenched, relatively dormant, their depredations limited and their poisons neutralized. But at any time there may come a change. Another disease may affect the general health. Perhaps adjoining teeth may become infected or the bacteria may start up an acute inflammation of the tonsils. Then the enemies break through the walls which have been thrown up about them to protect the surrounding territory, and the former intermittent skirmishing becomes a general combat. They are out in force, full of blood lust, eager for plunder and destruction.

As in the case of the hand infection, they leave by the blood or lymph streams. In the latter they find their destination and fate in the glands of the neck, which swell and become the sites of bitter conflict.

Those that get into the blood, however, will fare farther. Millions and millions will be destroyed, but that will not affect the activities of the others. Some will find lodgment in a remote organ or in distant tissues, where conditions favor their growth. They may stop in a joint or in many joints, causing acute or chronic arthritis; perhaps in the large muscles, and the result will be rheumatism. Or the heart lining may be affected and a chronic heart disease ensue. If the lungs are susceptible there will be a streptococcic pneumonia. Any place where the defense is weak may

become the site of their new growth. Focal infections of the teeth or nose or tonsils are now charged with producing thirty-seven acute and eleven chronic diseases.

Frequently the appendix throws open a hospitable door, offering a welcome. This little shriveled remnant of intestine has a poor blood supply and little resisting power. Soon the owner of the tooth abscess or diseased tonsil will begin to experience an uneasiness deep in the right side of the abdomen that may be so ill-defined that he is unsuspicious. That is chronic appendicitis, and will bear watching. Or his pain may be acute, with fever and all the symptoms of an acute fulminating attack. Pus will form and will need immediate exit. Call the surgeon, for death is approaching with quickened footsteps.

The ability to overcome bacteria and antidote their poisons is called natural immunity. Everyone possesses it, but it varies in different individuals, and at different times in the same person. The devastating onslaught of one disease may lessen one's immunity to another. A prolonged attack of typhoid fever may render one susceptible to tuberculosis, the germs of which he has been successfully fighting and conquering since childhood.

During the influenza epidemic it was not that disease alone which slew so many thousands. It prepared the way for the bacteria of pneumonia by destroying all the natural defenses against them. After three or four days' illness, just at the time when the victim, weak and exhausted, was about to come off victorious, he was stricken with pneumonia and was unable to put up a successful fight.

Natural immunity may be broken down also by bad

habits. Starvation will weaken it, but so will overeating, which taxes the liver and kidneys beyond their power of endurance, and clogs the blood with waste. Care is another friend of bacteria. Constant anxiety will reduce all the vital forces of the body. And so one might run the gamut of crimes against Nature. Impure air, dissipation, lack of bodily cleanliness, want of proper exercise, continuous work unrelieved by open-air play—all these and many more will lessen the natural resistance to disease.

An additional, greatly increased immunity to certain diseases may be acquired by a successful fight against them. Smallpox, for instance, and scarlet fever seldom succeed in bringing down the same victim twice. With certain other diseases, such as typhoid fever and pneumonia, this acquired immunity does not last indefinitely. Sooner or later the chemical substances stored in the blood disappear, and only the original natural immunity, the power to manufacture them again in case of need, remains.

But in each disease the acquired immunity is active against the bacteria of that disease only. It will antidote the poisons of no other disease than that for which it was made.

There remain two other kinds of acquired immunity, of which one is created within the body, and the other is obtained from animals. It is a curious and wonderful fact that dead germs will rouse Nature's fighting forces also. The introduction of dead bacteria will not produce a disease, but they will stimulate the manufacture of the chemical antidote for the disease which would result from the presence of the living bacteria. This is the basis of the theory of vaccination.

The chemical substances manufactured and stored

in the blood serum are another valuable aid in the prevention and treatment of diphtheria. In the making of these the horse is used. The animal is inoculated with diphtheria bacilli, and when all his combative forces are roused, when his fighting blood is up, a quantity of his blood serum is drawn off. This is the antitoxin which has saved so many lives.

All persons who have diphtheria manufacture this antitoxin, but it is a slow process and about twenty-five per cent of the victims would die if left to their own defenses. Help must come quickly from outside the body. And the blood serum of a horse that has fought and conquered the disease furnishes the necessary antidote.

More and more antitoxins are coming into use. The terrors of pneumonia will soon grow less and the victims of influenza decrease in number. Even the ever-present pus bacteria which cause so many and varied troubles—boils and rheumatism, sore throat and pyorrhea and appendicitis among them—even these germs are being combated by the aid of antitoxins.

This war of two kingdoms has gone on unremittingly from the beginning of organic life, and will last forever, but its human toll is growing less and less with every succeeding year.

It is no longer a fight against unseen enemies. Science is bringing to bear in our behalf each year new and more potent weapons.

But science will never conquer of herself alone. After all, each one of us has the forces within him which outweigh all and every external help. It should be the business of each one to conserve them, to keep them up to their highest efficiency.

TEN

EATING TO LIVE

IF we were all as physically active as our early ancestors, if life were as simple and uncomplicated with us as it was with them, when men had to hew and dig, to hunt and carry and labor with their hands, we would not need to concern ourselves with the subject of what to eat and would be interested only in the problem, how to get enough of it. We should be like the very old lady who was asked to what one thing more than any others she attributed her longevity. After a moment's serious thought she replied: "I think it was vittles!"

But life is not as simple as it used to be; it is complicated by a great many things, such as hurry, worry, sedentary occupations; and rich viands, without which our forbears managed to get along very well.

In consequence there are all kinds of sectarians in diet who are endeavoring to solve the problem, each group not only for themselves, but for the rest of us. And they are enthusiastic and vocative, and all are addicted to the pen or the typewriter.

Among these various sects are the Fruitarians. They eat nothing but fruits and nuts. Simple Lifers, they are called in England, and they go about the country eating little and wearing not much more. Then there are the Vegetarians, who eat nothing that does not grow above ground. And a sub-sect of the Vege-

tarian family who refuse all cooked foods but dote on raw grains. And the Lacto-Vegetarians, who add to their daily menu milk, butter, cheese and eggs. At the other extreme are a few persons who eat meat only, or at least they go for a more or less extended period on an exclusive meat diet.

And there are no-breakfast devotees, who quote from *Ecclesiastes*: "Woe to thee, O land, when thy king is a child and thy princes eat in the morning!"

The very orthodox of this sect eat but one meal a day and periodically they fast. Extremists have set up fasting as a cure for all curable conditions, and they have been known to deny themselves all sustenance for many days, thus emulating Dr. Tanner and Upton Sinclair.

In all this maze of diction and contradiction regarding food there is some truth. There are certain essential facts which are so well established that they may be set forth briefly within the limits of this article.

But perhaps it would be well to begin with an understanding as to what food is, what we do to it, and what it does for us.

The lowest form of animal life is a mere speck of jelly-like material, or protoplasm, having no permanent form and no organs of any kind. The amœba, which floats in the water, is an example of this simple life. When the amœba comes in contact with a smaller object it folds itself around it and digests it if it is digestible. Any part of the amœba has the power of digestion and absorption.

Animals a little higher in the scale of life have a pouch with a single orifice, into which food is taken and from which that part which cannot be used is

ejected. Still higher animals have two orifices to their food receptacle.

From this on, as we go higher and higher, the digestive apparatus becomes more and more developed, until we reach man, who has the most intricate and complex of all, a digestive tract more than twenty-five feet long, with many accessory organs.

But food in one's stomach is not inside the body any more than the tiny speck is inside the amœba that has just enfolded it. Food must be prepared for absorption and then absorbed before it really gets into the body. In order to understand what we do to food and what it does for us, suppose we follow a meal into the body proper, and see what becomes of it.

Let the one who is to eat this meal be hungry. Really hungry. What causes hunger? Need of food, of course. But what causes the pangs of hunger? Strong contractions of the stomach. The stomach contracts rhythmically when food is present, but these movements are strong enough to become uncomfortable when food has been denied a long time. The expression, "gnawing hunger," is based upon a real sensation.

Also let this meal be a good, ordinary dinner, of sufficient amount, neither stinted nor too abundant. Here is the menu: Consommé, steak, a green vegetable, potatoes, a salad, bread and butter, and a sweet dessert, ice-cream if you please. The beverage shall be milk because it contains all necessary food ingredients. Coffee and tea are not, properly speaking, foods.

Before being called to the table there is an appetizing odor from the kitchen, and immediately one's "mouth waters" in anticipation. Savory odors cause activity of the salivary glands because saliva is the

first aid to digestion. And, although it causes no sensation, the stomach waters also. The gastric juices are beginning to pour out. Unsavory food will not cause this phenomenon and lack of appetite will prevent its occurrence, so that digestion will be delayed.

Pleasant or unpleasant emotions also have a great influence upon digestion. Dr. Lusk says:

"The appetite is like a magic wand, influencing the whole of the digestive process. Fear and anger lead to a parched throat, so that food cannot be well digested under these circumstances. The appetite is affected by the atmosphere of cheer at the table. Neither scolding parents nor snarling children facilitate the digestion of the Christmas dinner."

But in this instance the appetite is sharpened by hunger and by the taste of the food, flavor depending largely upon the sense of smell. And the surroundings are pleasant. Nothing present, past or future, will spoil the digestion of our meal.

First, the consommé. There is not much nourishment in a clear soup; most of that has been strained out, in the solid ingredients. But its use is chiefly as an appetizer, further to stimulate the pouring out of the digestive juices.

Then comes the solid food, steak, bread and butter, and the vegetables, which will engage the attention of the teeth. Human teeth are of two kinds, those characteristic of flesh eating animals and those possessed by the vegetarian. This fact should settle the question whether man was intended to live exclusively upon vegetable food.

How long should each mouthful be chewed? That depends upon the kind of food. Digestion of starch begins in the mouth, where the saliva starts the chemi-

cal change of starch into sugar. Starchy vegetables should be thoroughly masticated and mixed with saliva. Flesh-eating animals bolt their food. Watch your dog eat meat. His teeth are meant chiefly for tearing and rending. This is not to advocate the bolting procedure on the part of man but merely to indicate that meat need not be so finely divided as vegetables. If it becomes too pulpy it is less easily acted upon by the digestive juices, and also it becomes tasteless and insipid before it is swallowed. On the other hand starchy foods are rendered more and more palatable, because they become sweeter.

In the mouth, then, the various ingredients of this meal are broken into fragments, mixed with saliva and mucus, and swallowed, the mucus being useful as a lubricant, to facilitate swallowing. Digestion of starch has begun, and the whole mass has been softened by moisture.

When it reaches the stomach it finds some gastric juice waiting for it, an amount that gradually will be increased during the succeeding three hours until about a pint has been used. The principal ingredients of this fluid are pepsin and hydrochloric acid, the latter being necessary in proper proportion to enable the pepsin to act. If there were too little, digestion would be retarded, and if there were too much, there would be that uncomfortable sensation commonly known as "heartburn," a very inappropriate name for over-acidity.

But before this meal goes any further it will be necessary to use other terms in describing it than meat, vegetables, bread and ice-cream. It consists of proteins, carbohydrates, fats, many minerals, water and certain waste material which cannot be used.

Proteins are the nitrogenous elements of food. They are found in all flesh and in nearly all vegetables, but in varying proportions. The starchy vegetables and grains, such as potatoes, and the kernels of the grain, for instance, contain an extremely small amount of protein.

All protein comes primarily from the vegetable kingdom. Animals have no mechanism by which they can transform nitrogen into flesh. But plants have that power and animals get their protein from plants. When we eat meat we get our protein second hand.

But this meal which we are following contains both vegetable and animal protein; in the meat, in the wheat bread, in the salad, even in the ice-cream; and the stomach begins their digestion. The gastric juice does not merely dissolve food, it begins a series of chemical changes which are completed further on. When finally the proteins have been made ready for absorption, they have been transformed into eighteen different compounds, from which the tissues will take according to their individual needs.

The carbohydrates, which are the starches and sugars, are not changed in the stomach, except that the starch is acted upon by the saliva which has come down with it from the mouth. The fats also pass into the intestine unchanged.

While the meal is mixing in the stomach there will be time to mention the famous Alexis St. Martin case. In 1832 Alexis St. Martin's gun discharged prematurely, tearing a great hole in his abdomen. He survived the accident but his wound never healed. By good fortune, in the small town near the Canadian border where he lived there was a United States army surgeon named Beaumont, who possessed an inquiring

mind. This surgeon cared for the unfortunate St. Martin and after he was able to get about, took him into his employ.

For several years Beaumont studied stomach digestion through the unhealed wound. His reports of these observations marked the first great advance in this hitherto obscure subject.

But very little was known of the movements of the stomach until the X-ray disclosed them. If, instead of an ordinary meal, it contained a simple food like cornstarch, or oatmeal, and a substance impervious to the X-ray, its movements may be watched through the screen. The substance most frequently used for this purpose is barium sulphate, the minute particles of which coat the stomach walls and outline it plainly in shadow on the screen.

Have you ever watched a horse swallowing and noticed the successive waves which pass along its throat? These are caused by muscular contractions which narrow the tube behind and push forward the water or food. The action is called *peristalsis,* and it it continuous throughout the entire length of the digestive tract.

In the stomach which contains the drug these rhythmic waves may be seen following one another, gradually mixing and advancing the contents, until they reach the exit, where at intervals the door opens and they are ejected in spurts into the intestine.

There is time to describe another interesting experiment by means of which these movements have been still further studied. After the barium sulphate meal has been swallowed, let the person to be observed take a capsule containing a little of the pure drug. It can be seen as a small and darker shadow, passed over

by successive waves but gradually moved on, like a cork upon the surface of a pond.

In this manner food is mixed, partially digested, and finally passed out into the intestine where further and more complicated processes await it.

To return to the dinner which we have set out to follow, before it leaves the stomach it has become semi-liquefied, of about the consistency of a thick broth. Very little of it has been absorbed because the stomach is almost exclusively a mixing chamber.

The small intestine is also lined with glands that secrete digestive fluids, and into it are poured two very important elements, bile from the liver and pancreatic juice from the pancreas. The latter helps to complete the digestion of the proteins, the sugars and the starches. Another important function is to break up the fats. But it cannot digest fats without the aid of bile. Bile and pancreatic juice must always work in combination.

There is a very ancient medical joke which runs: "Is life worth living? Well, that depends upon the liver." It is literally true that life and health do depend upon the liver perhaps more than upon any other single digestive organ. The normal secretion of bile is about a pint in twenty-four hours. It has many uses, among which are to assist the pancreatic juice in digesting starches, proteins and fats. Fats, even when finely divided, as emulsions, cannot be absorbed. The bile changes them into soap, which is soluble. This process is much the same chemically as occurs in soap factory.

Bile also helps the forward movement of the digested food, and hastens the progress of waste ma-

terial. If it were not for the bile we should all be poisoned.

And the liver is a storehouse for fuel, a coal bin, if you please, in which sugars are kept for future consumption, and fats also. Sugars and fats are our chief sources of heat.

Our meal has now undergone many wonderful changes. It is one creamy mass in which the separate ingredients could not be recognized. Steak is no longer steak, but the meat and vegetable proteins are now eighteen chemical compounds. The potato and part of the bread are sugar; the sugar which was in the ice-cream and cake is modified in form, and the fats have become soap and glycerine.

In the meantime, because digestion does not take place all at once, absorption has begun. The liquefied digested food, is passing into small vessels that line the intestinal walls. And from these it gets into the blood stream, in which it will be carried to every part of the body. Each tissue, whether skin, bone, muscle, or brain, will select the kind of nourishment best suited to it.

Let the experts juggle with carbohydrates and proteins if they will. We want to know a few practical facts about food. And we might begin with the question: What use do we make of it after it has been absorbed? Afterwards we may concern ourselves with attempting to determine just what is over-eating.

Taking the first question first, food is of two kinds, that which builds up or replaces, and that which burns up, to supply heat and energy. The building foods are the proteins, the minerals and water. The fuels are the fats and those sugar compounds which have been made from starch and cane sugar. The sugar

compounds formed by digestion differ chemically from both the original materials. The fats were changed into soap and glycerine for the purpose of absorption only. After this has occurred the glands lining the intestinal walls again transform them back into finely divided fat.

There are several great storehouses for fat in the body, where it is kept for future use. One is just beneath the surface of the body, under the skin. Another is in the membranes which hang like curtains over parts of the intestines. From this latter fat-deposit in animals is obtained the suet that we buy at the meat shops.

From these storehouses is drawn the burning material in times of famine or plenty, but in plenteous days it is constantly being replaced and the supply is not diminished. The hibernating bear during a season of foraging lays up great quantities of fat which he uses to make heat throughout his long winter's sleep.

The story of the journey of a meal from table to tissue would not be complete without a paragraph or two about germs, those minute forms of vegetable life with which we contend in our struggle for existence from the cradle to the grave. Germs may be friendly as well as inimical. Life without the friendly germs would be difficult if not impossible, and a sterile, germless existence is inconceivable.

They do not inhabit the stomach but are present both in the small and large intestine, where they are an aid to digestion. In the small intestine they assist in changing starches into sugar and in digesting fats also. In the large intestine they attack the proteins which have not been completely changed. And therein

lies a danger. If one has eaten too much protein food in proportion to the amount of starch and sugar, they will change it into poisonous compounds. These decomposition products are similar to those which occur in meat or vegetables too long exposed to the air before they are eaten. But they may occur in the lower bowel also, especially if waste material is retained. In either case the result is putrefaction, and absorption of such material causes auto-intoxication.

Which brings up the subject of waste, that part of everything edible which cannot be used. The proportion of waste varies with different foods, but it is greater in the vegetable kingdom than in meat, and some vegetables contain more fiber, or cellulose, than others. One thing certain is that it is necessary to health.

Bulk stimulates the movement of the lower bowels and prevents the accumulation of material which becomes poisonous if allowed to remain too long. This is another reason why meat, which is a highly concentrated food, should be eaten sparingly. Some of the vegetables that are useful because they are composed of a large amount of cellulose, will be mentioned later.

There are important food elements called *vitamines* about which comparatively little is known. What is known is that they are present in all proteins and that without them life could not exist.

They are in all fruits and vegetables, and in meat because they are an essential part of the proteins which the animals obtain by eating vegetables. Also they are in milk for the same reason. The outer layers of cereals, such as wheat for instance, contain the vitamines, and hence they are not present when

these layers have been removed, leaving only their starchy centers. The manner of their discovery may be interesting.

Beriberi is a disease much more common in European and Asiatic countries than in America. Its principal characteristics are, pains throughout the body, impoverished blood, dropsy, wasting of the muscles, and paralysis. In extreme cases death results from a weakened heart muscle. Until a short time ago physicians thought that it was a germ disease. Almost all obscure diseases are attributed to germs, until an alibi is proved.

Beriberi was once quite prevalent in the Japanese army when polished rice was almost the sole ration, but it disappeared when the soldiers were given a more varied diet. Polished rice is that from which the outer layers have been removed, leaving only the starchy kernel.

Then scientists in many places began to experiment to see if they could produce beriberi. One of these experiments was as follows: Fowls were fed upon polished rice exclusively. Within a very short time they began to be affected, staggering about drunkenly, too weak to stand. In six weeks they were paralyzed. Then the rice hulls were added to their diet and they all promptly recovered.

And so it was determined that the vitamines are necessary not only to health but to life itself. They are contained in concentrated form in the outer layers of grains, and for this reason whole wheat flour is much more nutritious than white flour.

The other elements which compose every meal may be dismissed with a very few words because they do not have to be digested. And yet they enter into every

digestive process and into the composition of every tissue of the body. They are the minerals and water. The minerals are derived from every form of food. They are many and their compounds are too complex to be mentioned in detail here. One important function of the minerals is to assist in the chemical changes which are involved in the processes of digestion and assimilation.

Finally, our meal has reached the tissues and has become a part of them in a manner not yet wholly understood. But we know that each, whether bone or brain, heart-muscle or hair follicle, skin or mucous membrane, has taken the proper sustenance unto itself to restore tissues that have broken down and been carried away by the blood stream to be cast off, or has been burned up to supply the heat and energy necessary to keep this wonderful machine of ours going.

A part of it will renew the heart muscle which, by its contractions, sends the blood stream through the minutest vessels with force sufficient to insure its return to the heart. A part will supply the brain, which will make an end-product of it in the form of action and emotions. And so we might trace this meal, in imagination, to great thoughts and heroic deeds.

Now that we have finished digesting and assimilating a well balanced, rational meal, of sufficient quality and quantity, we come to the question of overeating. And immediately we encounter difficulties because people differ so radically and so variously concerning it. Probably more books and magazine articles have been written about this phase of the question than about any other subject that deals with the human body.

The Fruitarian thinks that the Vegetarian overeats, and the Vegetarian considers it irrational to eat any

meat at all. And there are an increasing number of persons who weigh and balance their food, holding that one is a glutton if he satisfies a normal appetite and refuses to leave the table hungry.

These differences of opinion will never be reconciled as long as there are individuals who think for themselves, so there will be no attempt made here to settle them. With the advancing centuries the standards of eating have changed. In a sense, there are more people now who overeat than ever before, but it is because there are more people able to indulge their appetites. But gluttony is not fashionable any more, and the trencherman is no longer a hero.

It is probable that there were fasters and food faddists in ancient times, but on this point history is silent. It was the ones who ate the most whose names were celebrated in song and story.

The first name that occurs to one in this connection is that of Heliogabolus. It is related that he and his banquet guests were wont to eat several meals at a sitting. They used the kindly offices of a feather in the throat to bring about a reversal of the swallowing process and thus make room for another meal.

Such a procedure would be inconceivable nowadays. And yet there are modern counterparts of those Romans, who differ only in degree, not in kind. For instance, there is the parent who allows a child to eat too many and too rich viands at a party, knowing that there is plenty of castor oil at home. Also the man who overindulges in food and drink at a dinner because, just before going to bed, he intends to take three brown pills and two headache tablets.

Next in the list of gustatory heroes may be mentioned Louis XIV. When Louis was in form it was not

at all unusual for him to consume at a single dinner the following: Four plates of soup, of different kinds; a whole pheasant; a partridge; a salad; several helpings of roast mutton; two large slices of ham; a pastry; and preserved fruits and nuts. Note the semicolons in the preceding sentence. They are intended to represent short pauses between courses, for breath.

Is it any wonder that the "Grand Monarch" had to take a cure frequently, when he went into retirement for several days and was dosed with calomel and sulphur? These periods of retirement, rather than his gluttonous habits, enabled him to live to an over-ripe old age.

Savarin immortalizes a General Bisson by relating that he drank eight bottles of wine while eating a huge breakfast, and tells of a certain Prosper Sibuet who, on a wager, ate a whole turkey—after dinner!

That will do for historic examples. With us, such feats are no longer glorified and emulated. But overeating may be just as harmful, although only relative. Those who perform severe manual labor or live in an extremely cold climate may eat with impunity an amount which, if consumed by one of sedentary habits, would be unsafe and immoral.

An Arctic explorer once witnessed an Eskimo eat twenty pounds of raw meat, and wash it down with a quart of train oil. But the Eskimo needed fuel against the cold and his opportunities to obtain it were infrequent and precarious.

Overeating begins as an occasional indulgence, which if often repeated soon becomes a habit, and finally a vice. The occasional gustatory spree, usually at a formal dinner, or upon a holiday, may do no permanent harm because Nature takes care of it. An over-

loaded and indignant stomach will often rebel, to our temporary discomfort but lasting benefit.

In spite of the dictum of those who insist that one must always leave the table hungry, physiologists say that there is no harm in laying up a small store of reserve fuel. It may be needed at some future time for extraordinary mental or physical effort.

But there is no physical or moral extenuation for the chronic overeater. The immediate results of such a habit are fatigue, drowsiness and finally stupor.

Do you remember Joe, the fat boy, at whom Mr. Wardle was always shouting: "Joe! Damn that boy, he's asleep again." Joe had an overpowering predilection for meat pies and mutton and roast beef. He is a humorous character, in fiction. But in real life he would be Tragedy personified, because Joe was a victim of chronic poisoning.

Nature's laws, like the mills of the gods, grind slowly. After having established a tolerance for too much food one takes on increasing girth. This is due not only to the layers of fat in the coal bins of the body but to dilatation of the stomach and bowels. The liver also becomes engorged.

Gradually the kidneys become chronically diseased, broken down by their increasing labors in carrying away the food products which are so greatly in excess of the demand. Then degenerative changes take place in the blood-vessels, followed by high blood pressure. And finally, a weakened heart muscle breaks down under the strain.

Let one who has such conditions more or less advanced go to a banquet. Perhaps he is to speak. He eats more than usual, even for him. He rises to his feet, his face flushed—probably it is dark red—to

respond to a toast. Then, possibly before he has opened his lips, he falls.

"Indigestion" is the general verdict. But chronic indiscretion would be nearer the truth, long continued and repeated indiscretions. What has occurred is only a climax. A stomach distended with food, and the excitement are the final overload upon a weak heart and hardening arteries.

One may be a chronic overeater, although he eats sparingly, if he indulges his appetite for meat at the expense of vegetable food. The daily ration should consist of about one-tenth part meat, by weight. Any more is superfluous and much more is harmful.

Conversely, those who habitually eat too much meat, are underfeeding, because they are denying themselves certain forms of food which are essential to the preservation of a healthy body. If any kind of food can be spared without resultant harm it is meat, but the well-balanced diet for the healthy person contains both meat and vegetables in proper proportion, the vegetarians notwithstanding.

The general rules for rational eating may be summed up in the following dietetic decalogue:

Eat when hungry.

Most of us eat at least one meal a day for the sole reason that it is meal time and not because appetite leads us to the table. Omit a meal occasionally if you are indifferent to it. Hunger is necessary to perfect digestion and lack of hunger makes food a burden.

Eat less than you have been accustomed to eat, especially less meat.

Thus saith the Preacher, in Ecclesiastes: "Blessed

art thou, O land . . . when thy princes eat in due season, for strength, and not for drunkenness!"

Eat a variety.

Here the case of an English physician may point the moral. Experimenting with himself in an endeavor to find out the minimum amount of food which would sustain life, for forty days he lived upon bread and water, then for a month upon sugar and water, and finally for three weeks upon bread, water and olive oil.

He proved conclusively that he could exist for ninety-one days on bread, sugar, olive oil and water. But unfortunately for the experimenter, he died of scurvy very shortly afterward. It was not lack of bulk that caused death but lack of variety. A very small proportion of fresh vegetables and fruits would have saved him.

Chew thoroughly, but not excessively.

Observe the golden mean between voracious bolting and protracted chewing; discriminate between the meats and starchy food in this respect. And by no means anxiously count the number of chews to a swallow, or you may become morbid and introspective. Besides, the meal will lose all its zest.

Eat plenty of bulk.

That is, foods which are composed largely of cellulose, which is necessary to facilitate the onward and downward movement in the digestive canal. Among these may be mentioned lettuce, spinach, cucumbers, tomatoes, cabbage, radishes, onions, celery, asparagus and carrots. Skins of fruits, such as the apple and the grape, are good also if well chewed.

If the amount of waste which you are able to get in this diet is not sufficient to stimulate the lower bowel, take a tablespoonful of bran with your coarse oatmeal in the morning.

Eat fruit.

Both raw and cooked fruits are good for their laxative qualities. Drink fruit juices also between meals. Besides, the acid fruits and berries contain certain elements which cannot be obtained from other sources. This, of course, with the reservation that some people cannot take acid fruits, especially raw, with impunity.

Drink water.

Plenty of it, but mostly between meals and not when eating. Do not use water or milk or coffee or tea to wash down imperfectly masticated food. A reasonable amount of fluid taken with meals will not retard digestion, but will pass through the stomach without markedly diluting its contents.

Avoid indigestible combinations.

Eat sparingly if at all, of fried foods, pies and pastries. Starch will not digest easily if cooked with animal fat.

Don't forget the vitamines!

A varied diet, which consists of fresh vegetables as well as meat will supply enough of them, but they are especially found in the whole grains. For this reason whole wheat flour and the old-fashioned coarse oat meal are valuable.

Finally, eat happily.

Nothing retards digestion more effectively than unpleasant emotions. Everything pleasing to the senses is a help, but the greatest stimulus comes from a contented, happy mind and congenial companions.

ELEVEN

EXERCISE

TOWARD the end of his long life Senator Evarts was once asked by a reporter to state by what rule or rules, habits or conditions he accounted for his longevity. His reply has been much quoted but probably it was intended to be witty rather than a statement of the literal truth. It was to the effect that he had always avoided every avoidable physical exertion.

Still, it was approximately true. There are many people like the senator, whose bodies are spare, and who live long because they have maintained a balance between demand and supply. They eat sparingly; hence they do not have to burn up the excess; and because their physical activities are slight they require no surplus nourishment.

However, man is naturally an active animal and needs physical activities to keep in perfect health. Before he became involved in the artificial conditions incident to modern civilization man was the hewer of wood and drawer of water, the provider and defender. "Man" is used here in the generic sense. The fact is that women did most of the work, men being engaged in hunting and fighting. Which was a good thing for women. Like men, women are better off for a little work. Those of either sex who live in physical idleness become soft and flabby, less efficient mentally and physically.

Fewer people of each succeeding generation have activities which require muscular effort, because of machinery, automobiles and telephones; and to more and more people work means effort from the collar button up. In consequence, physical exercise, which used to mean work, now has a different significance. And it has a variety of meanings also, depending upon age, sex and muscular development. To the child it means play; to young women, dancing, tennis, calisthenics; to young men, athletics; to those of middle age, a walk or golf. In an endeavor to keep fit some are compelled to resort to artificial methods, exercises which can be taken in ten or fifteen minutes daily, before or after hours of work.

But whatever its significance to each individual, it is a fact that the vast majority of people get too little exercise. There is not time in these days of hustle and worry, and even when moments of leisure come most people are too tired to take advantage of them. Mental weight—lifting and long-distance running sap the vitality more thoroughly than hard physical labor, and so a book and an easy chair lure them away from the great outdoors, about which they like better to read than to see for themselves. They are content to romp through the pages of a swashbuckling romance or ride with the movie cow-punchers thousands of miles on the screen. Their thirst for adventure is satisfied by reading about the perils of the deep. And many of the male sex obtain quite sufficient exercise in watching a wrestling match or even a game of billiards!

Those who constitute this majority, the great unexercised, for the most part belong to two groups. There are the thin ones, the sallow dyspeptics, who eat little and fuss much. They are thin because nervous

energy consumes tissue quite as fast as physical effort, and because those of nervous temperament are often dyspeptic. They view with disgust and alarm the exuberance and the gastronomic feats of others. They live long, many of them, because they take good care of themselves. A delicate stomach is often a blessing, and a robust appetite quite the opposite.

The other group of the unexercised is the fat ones. A good appetite, an easy-going temperament, a certain amount of prosperity have brought about greater production than consumption. They eat more than time and opportunity permit them to burn up.

Fatness and self-indulgence are reciprocal in effect, each begetting and fostering the other. This statement, if unqualified, may call forth indignant protests. So it must be said at once that there are exceptions. Some people are just naturally fat; no matter how little they eat they get fatter and fatter. They are the jolly, good-natured kind whom nothing worries, not even the sedentary life they lead. Nevertheless, there is no gainsaying that if these people worried more about their diet and about the lack of exercise, their tendency to corpulency would decrease.

Fat is cheaper tissue than muscle. It is less complex in structure and is more easily manufactured. Also it requires less blood supply and is readily stored in places where the adjacent muscles are less used. Hence it accumulates in masses in and about the abdomen of sedentary persons.

The body is a factory which takes in raw material, food, making it into tissue, a part of which it consumes in the production of energy. To get the best results there should be a continuous turnover. The product should be disposed of with reasonable celerity and the

plant kept running at an optimum speed. As with any factory, it is possible to run on half time, but it is not a method which promotes efficiency.

The chief end to be attained by exercise should be not to make athletes but to increase the efficiency of the body and mind. The immediate result of physical exercise is a quickening of the blood current. A brisk walk or a game of tennis or golf will send an increased blood supply through every organ and tissue of the body. Waste matter is taken up and thrown off rapidly; there is a general house cleaning which cannot be accomplished so thoroughly in any other way. A Turkish bath is a poor substitute, though it does dilate the capillaries and increase the activity of the sweat glands.

But the blood stream not only carries off debris; it supplies nourishment to the tissues, and the result is growth. The one exception to this is that fat is not increased by exercise. Fat is merely fuel to be drawn upon in the production of energy; consequently it accumulates during periods of idleness and is lessened by physical activity.

Each time a muscle contracts some of its cells are consumed, but during the rest period the loss is more than supplied by the absorption of nourishment, and new muscle cells are formed. In this manner repeated use increases both the size and the number of the fibers. Repeated exercise also improves muscle tone and quality, thickens the sheathes which bind the bundles of fibers compactly together, and strengthens the tendons by which they are attached to the bony framework.

This improvement occurs not only in voluntary muscles but in those over which the will has no direct

control, such as the heart. Just as the arm or leg muscles of the athlete grow with use, so will his heart. The heart of the Marathon runner is larger and stronger than that of the inactive person; in fact it is his heart which determines his success in the race. The capacity of the heart is increased as well as the thickness of its walls, and it is able to take in and pump out a greater volume of blood with each cycle of expansion and contraction. The lungs also expand. The volume of air which they are able to take in is greater. Exercise develops the air cells, enabling them to take in a greater amount of air and to throw off with greater facility the gases of combustion which the blood brings to them for that purpose.

Brain tissue is destroyed in the production of thoughts in the same manner that muscle tissue is used to produce its form of energy, and the blood not only washes away accumulated waste but replaces the loss by building up new brain cells. Muscles contract in response to the will. No movement of the body is so simple that it requires the used of one muscle only; there must be coördination of several muscles to accomplish the simplest act. The more complex the movements the more intelligent must be the mental concentration upon them. Tennis, golf, dancing, calisthenics involve mental as well as physical training. Consequently continued practice brings to pass a greater mental efficiency.

Why is an athlete able to perform a feat of strength or of endurance that would be impossible for one not so physically trained? The athlete has better muscles, of course, but that is not the only reason. The more muscle one has the less waste of tissue will result during the performance of an act of strength. But the

principal difference lies in the fact that training has brought about a better coördination of muscles, which permits the athlete easily to perform a feat that otherwise would be impossible.

The better developed one is muscularly, the longer he is able to continue any form of physical exercise before becoming tired. But exhaustion sooner or later will come to the athlete as well as to one who is untrained. Fatigue is a manifestation of poisoning, due to saturation of the tissues with the products of combustion. As long as elimination equals production fatigue is postponed, but as the poisons accumulate in greater and greater quantity one becomes first tired, then exhausted.

Any occupation will cause fatigue which requires long-continued action, however mild in character, without occasional intervals of rest. The saleswoman standing all day in the store becomes utterly exhausted. And yet on her way home a brisk walk will restore her energy to such a degree that she may be able to dance all evening. This paradoxical result is not purely mental. It has a real physiological basis.

Feats of endurance are more profound in their effects than those which entail intermittent efforts of strength. Standing is more tiring than walking, and a slow walk than a brisk one. To balance in an erect posture one must keep many muscles in almost continuous contraction. If these large trunk and leg muscles were to become paralyzed for a single instant one would fall to the ground in a heap.

Why, then, does a brisk walk after standing all day relieve fatigue? Partly because there is increased heart action, and the poisons of fatigue are more quickly eliminated. But something else also helps the

circulation. When the large muscles of the limbs contract and relax they intermittently press upon the large veins which return the poisoned blood to the heart, whence it is pumped to the lungs to be cleansed. It is self-massage which restores strength and vigor even during physical exertion.

In the same manner the poisons produced by intense mental concentration are washed away. The tired brain worker takes an afternoon off for golf or tennis, and comes home revived, invigorated in mind as well as in body.

An instance of extreme physical exertion is the three-mile race, because it requires the utmost of effort and endurance combined. Let us see what occurs to the runner to cause exhaustion. At the beginning of the race there is little change. If the runner is in good condition his pulse will be slightly increased, his heart contractions will be stronger than when at rest, and the rate more rapid. His respirations will be fuller and deeper, but not much more frequent. Muscle contraction, however, causes increased combustion. The ashes and gases are thrown into the blood in greater quantity than can be taken care of under ordinary conditions. Combustion produces carbon dioxide, and this gas, acting upon the nerve centers of the heart and lungs, causes the heart to beat faster and the respirations to increase in frequency. The blood flows in greater volume and with greater rapidity. The lungs expand in volume and more poison is thrown off in the breath. The capillaries of the skin dilate, the sweat glands are stimulated, and sweat also contains waste matter.

And so for a time the equilibrium is kept up, the poisons being eliminated as fast as they are manufactured. Thus the runner has been able to continue

without distress. A little later—perhaps during the second mile if the pace has been rapid—the runner must slow down or the poisons will accumulate in the blood and the tissues. He will show signs of distress, his breathing will be labored and difficult, and it will seem impossible for him to continue much longer. Then, about the end of the second mile, or two-thirds of the distance, there will come a change. The signs of distress will disappear and he will go on, make a final tremendous spurt of energy, and cross the line.

To every trained athlete comes this phenomenon of second wind. Athletes hold themselves back until they get it; if they did not they could not finish. Two things occur to produce it—expansion of the lungs and dilatation of the heart. The air cells increase in size, allowing more air to enter with each inspiration, and the dilatation of the heart increases its capacity for work. In all contests calling for endurance at maximum effort the heart dilates. This increases the volume of blood which can be taken in and expelled, and, singularly enough, stretching adds to the strength of the muscle, increasing the heart's resiliency. If this dilatation is not excessive a few hours' rest will restore the heart to its former size. Heart murmurs resulting from dilatation are quite commonly found in athletes, but they rapidly disappear. The normal heart may resume its former size and tone after extreme dilatation, which is evidenced by a weak, thready pulse, blood spitting and all the symptoms of collapse. There is danger, however, that permanent injury may result in the very young or in those beyond athletic age.

The runner who continues beyond his endurance shows exhaustion by his rapid and shallow breathing, quick, fluttering pulse, a feeling of constriction in the

chest and dizziness and throbbing in the head. His distress is manifest in every attitude and feature. The muscles of his face and neck are tense, his countenance is pale and distorted, the mouth is wide open, the veins of the head and neck are swollen. All these symptoms gradually disappear after a brief rest as the poisons are eliminated.

But the effects of too arduous exertion may last many months. In such a case there is chronic poisoning, which affects the central nervous system also. An athlete who has trained too violently or too long becomes stale. He is chronically tired, unable to endure ordinary exertion, his tongue is coated, his digestion poor. He is cross and irritable. His body being saturated with poison his natural defenses are weakened, and he is more susceptible to infectious disease. Even wounds heal less readily.

Man's natural predilection for physical activities is manifest at the earliest age. An infant a day or two old is able to hang suspended by its hands. This greater strength of the arm muscles as compared with those of the legs may or may not be proof of our ascent from a long line of ignoble forest ancestry, depending upon one's attitude toward the theory of evolution, but it does indicate that a child, weight for weight, is as strong as the average adult.

Even a very young infant cannot keep still, and its activities should be encouraged. Muscle coördination is developed by use. The child instinctively kicks and pulls. It should have something to kick against, something to grasp. There should be several hours daily of freedom from the restriction of clothes, on bed or floor.

The fat placid baby may be not a bit healthier or

better able to withstand the conditions incident to infancy, than the thinner, more alert and active child. Mothers are inclined to judge children by weight alone, not realizing that an excess of fat may be as harmful to them as to their elders.

The natural instinct for exercise should be encouraged. Babies should be played with, in spite of the indignant protests of professional child nurses who prefer sluggish babies. They should be rolled over, picked up, allowed to grasp grown-up fingers; they should have something to kick against and something to pull. In this manner their physical training is begun at the earliest possible age. Properly done, a little playtime each day, there need be no fear of teaching them bad habits. Sluggishness and apathy are habits which may be acquired very early, and are difficult to overcome.

The child loves to climb and this should be encouraged. It will pull itself up by holding to the bars of the crib, and laugh with delight as it tumbles. Later will come more complex movements, picking up and throwing objects, standing and walking. Then there should be blocks for building, the sand pile for digging, and simple toys, all to accomplish not so much strength as muscle coördination, without which strength would be useless.

At about the age of seven a child of either sex begins to manifest more diversified activities, as indicated by the change in games. No longer content with blocks and sand piles, with digging and cutting — tag, prisoner's base, hoop rolling, marbles, jacks and one-old-cat succeed the plays of infancy.

Just at this time school breaks in upon their freedom, to keep them indoors, inactive for several hours

a day. Usually they make up for these quiescent periods after school and on Saturdays. Modern school authorities recognize the need of children for exercise, and sessions are broken by short periods of drill and play.

To the age of twelve there is little difference in the plays of boys and girls, except that girls early develop the mother instinct, as expressed by their love of dolls. From twelve years on, however, there is a wide divergence. Girls are hampered by the restrictions of clothes, and besides they cannot enter into competition with boys, having no inherited aptitude for throwing or striking. And they have no gang instinct.

This is the savage age with boys. They associate in gangs which have a leader or chieftain. Now also come the more active sports—swimming, baseball, football, skating, basket ball and hockey. The average boy from twelve to eighteen has little need of any set form of calisthenics to promote his physical education.

Girls also run, roll hoops and skip the rope during the early years of this period, but later their plays become more sedentary, and they should be supplemented by class exercises and games. Dancing is an efficient form of exercise for both sexes. It develops muscle coördination which results in grace of movement. And by fixing the attention, bringing to bear the force of will upon the complicated actions of the body, it educates the mental faculties. This is especially true of æsthetic dances, in the performance of which the muscles of the arms and trunk are used, as well as those of the legs.

From fifteen to eighteen years the average healthy boy usually possesses an ambition to become an athlete. Gymnasium and track training are begun at this time,

and are exceedingly useful; but these forms of exercise should be supplemented by calisthenics and games. Feats of endurance should be intelligently supervised, and broken by frequent periods of rest. In nearly all schools and gymnasiums each boy is given a physical examination before beginning training, and at stated periods during its progress.

These examinations should be made by a physician who has a knowledge of athletics. Distance running and wrestling should not be permitted until after a boy has passed his eighteenth year, because of the dangers of overstrain and exhaustion. Though the heart normally dilates during a long race, the immature heart is liable to extreme dilatation, from which recovery is slow and often never complete. In the latter case there results a permanent organic condition which will impair the boy's usefulness in after life and always remain a menace. The exhaustion caused by long-continued effort may last a long time. During this period a boy's vitality is reduced, mental efficiency lowered and defenses against disease broken down.

After eighteen there is less danger from violent exertion. The more mature heart adapts itself to unusual strain, and the ligaments about the joints are stronger, limiting the range of movement and lessening the danger of joint injury. Another important factor is that the older boy has better judgment and will curb his ambition within the limits of his vitality.

The needs of young people of both sexes are in the direction of physical development, and for this reason a part of each day should be spent in the gymnasium. The ordinary games are too wasteful of time for the small amount of exertion required. Dr. R. Tait McKenzie, professor of physical education at the

University of Pennsylvania, has estimated that during a nine-inning game of baseball an outfielder spends one-half of his time standing with his hands on his hips, three-eighths sitting on a bench, and the remaining one-eighth at bat, running bases and throwing the ball. For an expenditure of two hours or more he gets nothing but fresh air and a little exercise for his right arm and shoulder.

Football is generally thought to be a rather violent form of sport. And yet, says Doctor McKenzie, "in one hour of football, the time occupied in actual play is about ten minutes, the rest of the time being spent in discussion, disentangling the team after a play, and in preparing for the next play, the exhaustion following a game being largely nervous."

To most people whose daily duties do not require much physical activity, somewhere between thirty-five and fifty there comes the realization that youth is vanishing. The heralds of middle age are many. There may be a lessened appetite, increasing girth, sleeplessness, shortness of breath with fatigue on moderate exertion, and a gradually diminishing power of concentration. In one form or another, perhaps in several, these harbingers of age gradually force conviction.

Some are content to watch the approach of the autumnal season with the placidity born either of laziness or of a fatalistic philosophy. Winter is coming anyhow, think these latter; what matter a few years more or less? But not so with the majority, whom pride, if no higher motive, urges to look about for the cause and the remedy, and they are fortunate who find a cure in exercise. It is not a panacea, but if there is no organic disease it will go far to check the

speed of fleeting youth. It will make the thin fatter by increasing appetite and promoting digestion. In the stout it will burn up the superfluous fat, hasten the elimination of surplus food products which result from overeating; and it will add to mental and physical efficiency.

Though it is no less true that those who are thin need exercise as well as the fat ones, pride usually impels the latter to seek for a remedy much more insistently than the former, and to look forward apprehensively to the time when they will not be able to see their feet. In this respect men are as much influenced as are women.

Of the fat men many were once physically active, and some of them were athletes, but the old training days have long since passed, superseded by years of office work. The former athlete who assumes the sedentary life usually retains only one of his earlier habits, strenuous exercise with his teeth. Good appetite and perfect digestion in his case are by no means unmixed blessings, because he does not burn up the excess of fuel.

When a man suddenly awakens to a realization that something must be done if he is to be kept out of the class of the obese he will follow one of several methods with that purpose in view. If he has been an athlete and there has not been too long an interval since his athletic days he may begin a course of systematic training. If so he should realize that a man over forty cannot safely do the stunts of former years. Distance running, weight lifting, any form of violent exertion may cause permanent dilatation of the heart or the rupture of a blood vessel, most likely in the brain. He would better begin with the mildest form of activity,

increasing the time and effort involved gradually as his strength returns.

If his spare time is limited he may take up a course of calisthenics at home, using the knowledge acquired in his youth or following instructions obtained from a correspondence school or an instructor.

This tabloid form of exercise is all right provided he observes two precautions. The first one concerns limbering up. Recalling the feats of his youth he may attempt to make himself as supple at forty or more as he was at twenty. It cannot be done without danger of injury to the joints. Ligaments which bind the bones together at the joints grow tenser and less elastic with advancing years, and are liable to rupture when overstrained. It is a common occurrence for adults, both men and women, to tear one or more ligaments at the juncture of the spine with the pelvis, by bending too far forward while in a sitting posture.

The other precaution has to do with respiration during exercise. The breathing should be easy, deep and regular. The practice of holding the breath in full inspiration while performing a vigorous movement a given number of times is extremely dangerous for those of middle age.

The blood pressure of the person beyond forty is normally higher than in those who are younger. Increased force of the heart contractions during exercise raises this normal pressure, and violent exertion may raise it beyond the safety point. If there is a weakened vessel wall, which more frequently occurs in the brain than elsewhere, it may rupture, and a hemorrhage ensue. Such a condition is called apoplexy.

But if the man who decides to get back is wise he will take up golf, swimming, rowing; perhaps tennis,

if he is not too soft. He will take longer and longer walks in the country, and if he has opportunity he will work in the garden.

The open air is the proper place to get rid of poisons in the tissues; a ten-minute exercise at home once a day is much better than no exercise at all, but it is a poor substitute for work or play outdoors.

Two-thirds of the stout persons of mature years are women. They are more apt than men to grow fat, for several reasons, some of which have to do with environment and some are incident to sex. After marriage many women drop all active pursuits except those within the home. Those who do their own housework and attend to their children have about as much exercise as they require. But to the woman with servants household duties are exasperating and harassing rather than arduous.

Nature has given to woman a better digestive apparatus than to man, to enable her to nourish both herself and her child. In consequence the average woman obtains more nourishment from an equal amount of food.

One day the woman who is growing stouter observes in the glass or in the tightness of her bands the startling fact. At once she thinks of diet, but it is only a passing thought to be translated into action at some future time.

As the layers of fat pile up, pride dictates that they shall be concealed as long as possible. And so strings are pulled tighter and tighter in the desperate attempt. Constriction impedes the freedom of the lungs by pressing the abdominal contents up against them; consequently there is shortness of breath. Breathlessness

in turn lessens physical activity still further, because it is so difficult to get about. The result is more fat.

Comparatively few women ever think seriously of exercise as an antidote. If they are sufficiently worried about themselves they try dieting. The trials are usually intermittent, however, because it is so hard to stick to a limited diet when one has a good appetite and good digestion. At best, even when followed with determination, dieting alone is a precarious method because it may be carried far. Many a woman has starved both her body and mind by insufficient nourishment, and has made herself receptive to the onslaughts of disease.

The best way to cure obesity is to avoid it. The wise mother will keep young with her children. She will walk, play running games, dance, swim, skate, ride, golf. However, the same precaution applies to her as to men, that all exercise should be begun with moderation, very gradually increasing as the education of her muscles progresses.

There are two criteria by which the kind and amount of exertion should be regulated. One is fatigue. The tired feeling which results from muscular effort should never be painful. Rather it should be pleasant, a languor easily relieved by rest and followed by a sense of new strength and vigor. After long-continued effort the muscles ache, interfering with rest, and the lassitude may endure for days. The other criterion is shortness of breath. The heart must be strengthened by patient training, because muscle grows only by repeated, gradually increasing efforts.

The most successful cure for obesity is a combination of exercise and diet. If one is getting fat mentally as well as physically he would better get busy

with outdoor exercise and restrict his diet. The easiest method of dieting is to omit one meal a day.

If a reduction in the total amount of food does not accomplish results certain fat-forming articles of diet should be restricted. These are the fats and the carbohydrates. Avoid or take sparingly of bread, milk, butter, fat meats, sugar, potatoes, rich puddings, pastry. One should especially eat less of anything of which one has been particularly fond and in the habit of eating to excess.

The total amount of liquids taken in a day should not exceed three pints, unless there is free perspiration. But the quantity should not be reduced much below this maximum limit or the kidneys will not be able to perform their work properly by excreting the solid waste matter in solution.

In general, one should eat less than the appetite seems to demand. It is a well-known axiom that the vast majority of people eat much more than they require. One who wants to reduce must do one of two things, either take in less fuel or burn it up more rapidly by increasing his physical activity. The surest means is a combination of the two.

Though much space in this article has been devoted to the effect of exercise upon fat, perhaps to the neglect of its more important and farther reaching benefits, these latter must not be forgotten. After all, health, bodily vigor, mental resiliency, buoyancy of spirits—these are the great results to be sought. Constant, unremitting work of any kind gradually dissipates them, and they can be restored only by a change of occupation.

Whether one works with his brain or with his hands, at a desk or in the home, there is need of relaxation;

not rest, but exercise. And it should come at frequent regular intervals to be of the best service, to keep the machinery up to the highest state of efficiency.

But do workmen need it? Watch a group of mill men during the noon hour playing ball or other games. They are resting the groups of muscles which are used when at work, and employing those which during work hours are at rest. Their brains also are stimulated by the exhilaration of the sport. And when the whistle blows they go back to their tasks refreshed.

Very little has been set forth here with which the reader will disagree. Everyone believes in exercise, but the difficulty is to put the belief into practice. Perhaps the reader's attitude may be something like this:

"Yes, that's all true enough. I wish I had the time, but I'm too busy. Ho, hum! I ate too much dinner to go for a walk. Next summer I think I'll go to the seashore for two weeks and lie round in the sun."

And the next morning he or she will spend two hours trying to get started for the day.

The truth is that the more one hates exercise the more one needs it.

TWELVE

HOW OLD ARE YOU?

THE number of years one has lived is not the sole standard by which his age should be judged. Some are old at forty and others are young at sixty-five or seventy. To the young forty seems old and sixty-five incredibly ancient. As the years increase age keeps receding, ever ahead, and the man of three score salutes his life long friend: "Hello, my boy!"

One's age, then, is not altogether or essentially a matter of years. It depends much more on the state of the mind, and most of all on the condition of the body. Some people live much harder than others, with consequent greater wear and tear upon the machinery. And this wear and tear more frequently results from abuse than from legitimate use. If one is old at thirty-five or forty it is not to be expected that he will live appreciably longer than if he had already reached sixty-five. As far as concerns himself he might just as well be sixty-five if he does not change his method of living so as to delay the inevitable end. Age should be reckoned not by the length of time one has lived but by the years to come.

The outward and visible signs of age are merely indications of what is going on within the body. Baldness is often an early sign, but it is a sign nevertheless, the evidence of impaired circulation in the scalp. Gray hair is another; and wrinkles, especially the folds in

the neck that hang down from the lower jaw, caused by absorption of fat; and from the same cause, the thinning hands, the skin of which will remain pinched up momentarily after pressure has been removed.

Subjectively there is a gradual lessening of the emotions—of joy, of the zest for adventure, of the passions; one by one their heights decrease in altitude. The appetite for food becomes less keen, and the desire for physical activity less insistent.

But long before these signs appear changes have begun that are neither tangible nor visible until well advanced. Whether they are to progress with rapidity or to be retarded depends at least in part upon ourselves.

Old age is unavoidable and its marks are indelible. If it came to all alike, relatively at the same time, there would be little use to write about it, and no use whatever to warn against it. But to some it comes prematurely, and of those to whom it comes with accelerated pace many could have postponed its advent if they had taken heed in earlier years.

As one's years increase there is a gradual deterioration of the organs and tissues, with lessening of function. This is met by a compensatory slowing up of the machine, a restriction of the field of activities. These processes normally come on so slowly that the summer of life glides into autumn and autumn into winter and one does not perceive the transition. That is the normal approach of age.

But senility, premature old age, is a different matter. It may be caused by bad habits, self-indulgence, passions, greed of wealth or fame—everything which overtaxes the delicate parts of the machine. The immediate effect of this misuse is the manufacture of

poisonous compounds within the body; and their continuous manufacture results in chronic poisoning, destruction of organs and decay. Seneca wrote: "Man does not die, but kills himself"; which would seem to indicate that the Romans were very much like ourselves.

"A short life and a merry one," is a favorite proverb with those who believe in going the pace either along the highway toward fame or wealth, or through the byways of illicit pleasure. But sometime they will discover that the short life is not a merry one; that the byways are only bright in spots; that even before their early termination there are more dense shadows than sunlight. Whether made merry by a mad pursuit of business or of pleasure, such a life toward the end is compassed about with infirmities.

This is not to decry work in proper measure. Work and recreation are both beneficial, both contribute toward long life and, what is infinitely more important, toward contentment. It is the judicious mixture of the two, however, which benefits, and not utter absorption in either to the exclusion of the other.

Premature decay may begin anywhere in the body, but there are favorite sites where in the majority of cases it is first made evident. These are the blood vessels, the heart and the kidneys; not necessarily in that order of their occurrence. Changes may have been going on in the kidneys long before they are manifested by any symptoms, and the arteries are quite often affected before the heart.

One may not have discovered anything wrong with himself until certain facts are brought out during a physical examination, perhaps for life insurance. Then, if the circulation is at fault, it is usually indicated

by high blood pressure and hardening of the artery walls, frequently accompanied by signs of impaired kidney function.

To say that one is as old as his arteries is to express a great truth—partially. Remembering that all the organs and tissues normally wear out as the years increase, and that any one or several of them may be broken down by misuse, one is as old as the weakest of them. Judged by this standard, how old are you? You may have a good digestion, but how about your arteries? You may be muscularly strong—are your kidneys normal? Your brain may be clear, your thinking consecutive, your capacity for mental tasks as great as ever; but how have you treated the other parts of the machine? It is as strong only as its weakest vital part.

Each part of this marvelous machine is so dependent upon all the others, and the general efficiency of the whole upon each and every part, that it would be difficult to treat their use and misuse within the limits of a single article. And so we shall consider particularly the circulation.

The circulation of the blood is brought about by two factors, a pump and a piping system. The latter is really an irrigation and a drainage system combined, with the added condition that the fluid must be pumped through the pipes with such force that it may return again to the pump. To accomplish this, much depends upon the condition of the pipes.

Every artery, from the great main, the aorta, to the smallest arterial branches, has elastic walls made up of muscle and elastic fibers. With every wave caused by the expulsive contraction of the heart the vessels distend and after the impulse passes they resume their

normal size. This expansion and contraction promotes the steady flow of the blood through the capillaries and its return to the heart by way of the veins. If the vessels were rigid the heart would have to exert more force with each contraction.

No pump devised by man ever attained such efficiency as the heart, or such power of endurance. When one is at rest his heart contracts sixty to eighty times a minute, and physical exertion increases this rate by about one-half. During a large part of every twenty-four hours the healthy person is exercising in one way or another.

Taking the average rate of heart contractions, at rest and at work, as eighty per minute, the heart contracts and expands in one year more than thirty million times; and in seventy years the total would be nearly three billions. No pulling of fires on Sundays; no stopping for rest and repairs, except for the fraction of a second at the moment after each expansion. There is need, then, that the circulation be unimpeded if disaster is to be averted.

Two changes normally occur with advancing age—arteriosclerosis, or hardening of the artery walls, and increased blood pressure. The aged have more or less hardening of the arteries, and because of the lessened vascular elasticity the heart must contract with greater force.

Within the vessel walls a gradual change ensues: the muscle and elastic fibers disappear, and inelastic fibrous tissue takes their place. This not only makes the vessels more rigid but lessens their caliber, thereby obstructing the circulation. Later, lime is deposited in the walls, and they become stiff and ringed, much resembling to touch a rubber hose bound with wire.

Blood pressure is a measure of the contractile force of the heart. It is high or low, depending in part upon the strength of the walls of the expelling chamber, the left ventricle; in part upon the needs of the circulation, the presence or absence of impediments; and in part upon the presence or absence of certain elements in the blood. Also, it is higher during exercise than at rest; it rises after a full meal, during the processes of digestion, and is increased by the use of tobacco and alcoholic drinks.

Arteriosclerosis and high blood pressure are so frequently associated that it is often difficult to decide which preceded the other; continued high tension causes degenerative changes in the artery walls and rigid arteries increase the tension. But as the causes which produce them are essentially the same they may be considered together.

Narrowing of the smaller conduit pipes eventually causes still further obstruction of the circulation by obliterating the capillaries. This is one of the easily observed phenomena of age. It is seen upon the surface of the body, especially the hands and face, in the pallor and looseness of the skin resulting from a lessened blood supply, and the disappearance of fat. Baldness is one of the first signs of this obliteration.

But the process also occurs elsewhere, though not so evident. It may affect the heart muscles and in the kidneys it causes replacement of the normal glandular structure by fibrous tissue, diminishing their power to eliminate waste. This tremendous decrease in the footage of the piping system by obstructing the circulation necessitates more forcible contractions of the heart and raises the blood pressure. And so we have this vicious circle of three, any of which may be the

origin, but all of them reacting each upon the others: High blood pressure, arteriosclerosis, chronic kidney disease; arteriosclerosis, high blood pressure—begin anywhere you choose and the two others, in all probability, will be added unto you.

The approach of premature decay is insidious because the changes are slow. They have been under way for some time before there are either signs or symptoms, but these will inevitably appear, given the proper causes, in man or woman, in the stout or the lean. However, let us take a typical case, a business man somewhere between forty-five and sixty. He may have started life with no capital save that best of all heritages, a good constitution, but this capital he has spent lavishly in exchange for success. His one dissipation has been work and its handmaiden, worry.

For purposes of illustration we might consider the case of the stout convivial man who has gone and is still going the social pace, or the woman of sedentary inclinations and habits of dietetic self-indulgence. The end is the same, though the minor changes may vary somewhat, so let us stick to our example.

Such a man should be in his prime, his physical powers perhaps slightly limited, but his intellect clear and his capacity for work at its greatest. In fact he will take occasion to tell you that he is as good a man as he ever was, not realizing that this very assertion implies a doubt. He would not think it necessary to tell you that he is honest or that he loves his family. Well, perhaps he cannot climb a hill as well as he used to; he is a little short-winded, but that is because he has not had time to get enough exercise. Too busy at the office, too many important deals on to permit his wasting time with golf or tennis or country walks. Or so he

thinks. But the fact is that habits of work and worry have been formed and though now he could take the time he doesn't realize it. Business has absorbed all his thoughts not only during business hours but it has gone home with him and has been his companion during all his waking hours.

For several years he has had an occasional slight attack of vertigo; merely a passing dizziness, which he attributed to his liver. For a year or two nothing more serious has occurred to attract attention, and the dizzy spells have become an old story. But the shortness of breath still persists; in fact, it is getting worse. He puffs now after less exertion. And, another thing, come to think of it, occasionally he notices, especially after dinner, a throbbing in his chest or neck, synchronous with the beating of his heart. Still there is nothing—except business—to worry about. If he is getting fat he attributes these slight inconveniences to that condition and decides that some day he must take up golf. Or if he is lean, nervous and irritable, he thinks he needs medicine to aid digestion.

As time goes on a new symptom obtrudes itself. Now and then on going into the cold air there is a tightness, a slight sense of constriction, in his chest. Several times he has felt it after running upstairs or for a train. If things would only let up at the office he really must get some exercise. This puffing and this tight feeling after slight exertion are annoying. Why, he remembers, at college —

Later, one night after a big dinner preceded by a few cocktails, he is roused from sleep by a sense of suffocation. He is really alarmed for a time. He cannot get his breath; he gasps and wheezes, clutches at his throat; he runs to the window and grasps the sill

with both hands, fighting desperately for air. In a short time relief comes with a loose cough, and he breathes more easily. But it was an ugly experience; indigestion, of course. He must watch himself at banquets. Those cocktails, especially the olives—

Now of course it was the cocktails and the overloaded stomach, but something else was behind it. Periodically for many years he has eaten and drunk too much. Why has retribution been so long delayed? Because now there is at least the beginning of a serious disturbance of the circulation which did not exist in his younger days. The attack is called, not altogether correctly, cardiac asthma. It is compounded of high blood pressure, hardening arteries and faulty elimination. The immediate cause was the presence of food poisons which his overtaxed kidneys had not been able to cast off so readily as when he was younger.

If this man is not insensately foolish he will obtain medical advice and mend his ways. Suppose, however, that he does nothing of the kind, that he goes on eating and drinking as much as ever, and working as unremittingly.

One day, after a good dinner followed by one or two of his favorite strong cigars, he is seized with a pain. Aud such a pain! It is a stabbing through the chest as by a sword thrust. It runs down his left arm and at the same time there is a tightness round the chest walls like the constriction of an iron band. He would scream if he could, but he cannot. Will he live to draw another full breath? Cold sweat is on his forehead, every muscle of his body tense, his face pallid, his pulse racing at an incredible speed.

That is angina pectoris. The attack usually does not last longer than a few seconds, or at most a few

minutes, but it seems quite long enough to the sufferer. True angina pectoris is caused by starvation of the heart muscle from hardening of the arteries which nourish it. Fortunately there are many cases of pseudo-angina which resemble the real disease but which are not caused by so grave a condition. Excessive use of tobacco, for instance, may give rise to these attacks, and their recurrence will cease if smoking is discontinued.

It would be unwise to discuss here the treatment of angina pectoris, because it is a condition which requires especial consideration of each individual case. The point to be emphasized, however, is that it lies at the end of the road along which our patient was journeying, and might have been avoided by a change of habits in earlier years.

Suppose that instead of ignoring earlier symptoms he had sought competent advice when shortness of breath first attracted his notice or the first spells of dizziness. Even at that time there was high blood pressure and a slight rigidity of the artery walls, and also, perhaps, evidence of chronic kidney change.

In such a case what would the doctor have advised? First, a complete change of habits. Less food, probably an exclusive milk diet for a while, with complete rest in bed, followed by a much restricted diet without meat. Then meat only once daily, in small quantity, and gradually increasing activity. Absolute interdiction of alcoholic drinks forever, and the use of tobacco reduced to a minimum. Freedom from excitement and strong emotions of every kind, especially worry. Then, after going back to the office, a certain amount of time spent daily in exercise, to be increased very slowly

as the muscles developed; also plenty of recreation in the open, but never any kind of violent exertion.

But above all the doctor will counsel moderation in all things. If his patient obeys implicitly these instructions he may hope with reason to improve and, what is most important, to check the progress of degenerative changes and to live out the time of his expectancy.

Before taking up the causes of senile changes a comparatively recent discovery of a cause of high blood pressure deserves attention. Sometimes high arterial tension is not associated with degeneration of the arterial walls, but nearly always in such cases there is chronic kidney disease. Once the theory was advanced that obliteration of the capillaries in the kidneys in itself raised the pressure, but that explanation was not satisfying. Later, attention was drawn to two little bodies, ductless glands, that lie one upon the surface of each kidney. They are called adrenals and the substance which they secrete, adrenalin, when injected into the blood acts on the nerve centers, elevating the blood pressure. In some kidney conditions these glands are overactive. Emotions such as fright or great sorrow also cause an excess of adrenalin.

This accounts in part for the high blood pressure of those of nervous temperament who for a long time have been under great mental strain. The other causative element lies in the digestive tract. Worry is usually attended by indigestion, faulty assimilation and overproduction of waste.

The harassing cares of modern business have the same effect as physical labor, producing waste in large abundance, but the sedentary life of the business man does not facilitate its elimination. Hence the irritating poisons remain in the blood and tissues, and can be

gotten rid of only by indulging in frequent periods of mental rest and agreeable physical occupations. Hard work of any kind, in proper dosage, never killed anyone. It is injurious only when it becomes a passion to the exclusion of everything else; then it takes the form of a dissipation as harmful as any other kind of self-indulgence.

Someone has said that we dig our graves with our teeth, to indicate the potent force of diet in determining longevity. Certainly nearly all of us eat much more than is necessary for our daily needs. What becomes of this excess? Part of it is stored up as fat, to burden us with overweight. Part lies in the lower bowel to ferment, the poisons of putrescence being absorbed. And the rest must be thrown off by the kidneys, which at best have all they can do as scavengers of the body.

Meat in excess is especially harmful to the kidneys, because its end-products, manufactured in the process of digestion, irritate their delicate mechanism and long-continued overwork will destroy it. Meat products in the blood also change the nature of that fluid and increase the blood pressure. For these reasons meat as an article of diet is forbidden if one has a high blood pressure with or without hardening of the arteries. But even healthy persons should avoid much meat if they wish to avoid destructive changes.

It may not be necessary to enlarge upon the effects of alcohol on the liver, the kidneys and the blood vessels as well as upon all other organs and tissues of the body, but it would be interesting to know just how many years it has taken off the average life of those who used it. There are other poisons not nearly so

powerful but nevertheless sufficiently so to deserve a word of warning. Tobacco, in excess, raises the blood pressure, not only by its influence upon the nerve centers but by its direct effect upon the heart. When smoke is inhaled the nicotine gets into the circulation in the lungs, and is carried at once to the heart, with irritating effect.

Even to the most hardened habitué excessive use is harmful, especially when accompanied by the inhalation of the smoke. The poison accumulated is in excess of the antidotes manufactured by the body, and among the evil effects is a raised blood pressure, which in turn brings the menace of degeneration of artery walls. Consequently the interdiction of tobacco is indicated when this process threatens.

Constant excessive use of coffee and tea is also harmful, because they also contain alkaloids which act upon the nerve centers of the heart.

Volumes and volumes have been written upon certain phases of the subject of health, especially about diet. The difficulty about most of these books is that their authors are enthusiasts, each one the champion of a special method or régime which has fitted his own case admirably but which may not be suitable for universal application.

The immediate incentive to write this chapter came from reading a little book written by an old man who himself had long outlived his generation and who desired to help others by telling them what methods he had used to ward off early decay. There is nothing didactic, in his narrative, nothing complicated or difficult to follow. The first edition was published in Padua in 1558, when the author was ninety-one. It was called *La Vita Sobria.* All its precepts may be

summed up by that title, *The Temperate Life,* which is much better than that given to the English translation, *The Art of Living Long.*

Surely the testimony of one who has run a long race should be valuable to other runners, and for this reason this book of Cornaro's deserves consideration; in fact for five hundred years it has been a classic in Italy and has been translated into many languages. It is of especial interest because he began life handicapped. One may say of some who have preserved their health and vigor to an incredible age that they had been better equipped than the average mortal at the beginning. But read the author concerning himself:

"Because I was born with a poor constitution I fear I shall not live much beyond a hundred years. Yet all those who are born delicate, like myself, would no doubt reach, in perfect health, the age of a hundred and more years, as I feel will be the case with me—were they to embrace the temperate life as I have done."

Luigi Cornaro was born in Venice in 1467 and died in Padua in 1566. Inheriting a delicate constitution, it was his good fortune to discover before it was too late, and to adopt, a manner of life which so marvelously prolonged his years. And yet, though he confined himself to a most rigid régime he did not attempt to force it upon others. He recognizes that each one must discover for himself just what particular articles of diet and what amounts of exercise, work and recreation are suitable to his needs. In substantiation of this truth he quotes an ancient proverb: "A man cannot be a perfect physician save of himself alone."

He limited his own diet to the least amount of food possible to sustain active life. For many years it consisted of soup, bread, the yolk of an egg; in all, but twelve ounces of solids daily, and fourteen ounces of a light wine. But he did not recommend this diet to others.

"However, those persons who are blessed with strong constitutions may make use of many other kinds and qualities of food and drink and partake of them in greater quantities than I do; so that even though the life they follow be the temperate one it need not be as strict as mine, but much freer."

In other words, no particular diet is applicable to all. Moderation is the essential requisite; to eat less than one's appetite seems to demand, and to stick tenaciously to this self-made rule in spite of the temptation to eat more, in spite of the importunities of well-meaning relatives and friends.

Once Cornaro himself weakened in this regard. When he was seventy-eight his family conspired to persuade him that he was not eating enough for one of his age, and the doctors added their arguments. He protested that he had lived and thrived on that amount of food for many years.

"I maintained, furthermore, that it was in harmony with reason that as my age increased and my strength lessened I should diminish rather than increase my quantity of food. This was true; since the digestive powers of the stomach were also growing weaker in the same proportion as my vigor became impaired. To strengthen my argument I quoted: 'Whosoever wishes to eat much must eat little'—which means simply that the eating of little lengthens a man's life

and by living a long time he is enabled to eat a great deal."

The wise old man understood better than his doctors or his friends the application to himself of the law of supply and demand. Nevertheless their arguments prevailed, and he yielded. To please them he added to his diet by taking two ounces more of food per day! Whereat he became sick, and they all thought he would die. Then, having proved his point at great inconvenience to himself, he went back to the original daily allowance, and lived twenty or more years longer.

But Cornaro did not rely solely upon a restricted diet. He observed moderation also in other directions. "I have also preserved myself, as far as I have been able, from those other disorders from which it is more difficult to be exempt; I mean melancholy, hatred and other passions of the soul, which all appear greatly to affect the body."

He knew nothing of the poisons created by anxiety and anger or by intense, unrelieved mental strain; nothing of the ptomaines resulting from the fermentation of excess food; nothing of blood corpuscles or germs. And yet his Temperate Life contains the very heart of the whole matter. He lived a life of activity in the fresh air, ate only what his body required, and kept his mind tranquil. Two words contain the whole of his gospel—temperance and tranquillity.

Is it worth while? Not if age implied merely weariness of body, racking pains, stupor of mind; in a word, infirmities. But if it means quite the opposite, it is very much worth while. A certain broad philosophy comes with vigorous old age, a calm but vivid interest in people and events, a better perspective.

"And who would not enjoy life at an age when it is

free from the innumerable miseries by which we all know the younger ages are afflicted!" Cornaro wrote that with his own hand at the age of ninety-one, eight years before he passed away like one who sinks into a calm and peaceful sleep.

The sooner one realizes how much the sum of his remaining years can be shortened or lengthened by his own conduct, the greater that sum is likely to be. And so the question with which this article began perhaps would better be stated differently—not How old are you? but How old will you be at thirty, at fifty, or at sixty? For to repeat what was said at the beginning: One's age should be reckoned by the number of years which are to come.

THIRTEEN

HOW HARD SHOULD WE WORK?

THERE are times when everything we do is easy, and we accomplish an incredible amount without becoming tired. We are full of energy, nothing troubles us, and we are happy in the consciousness of work well done. Again, there are days when nothing goes right, and difficulties which ordinarily would be insignificant seem almost insurmountable. At such times we look foward with longing to the time when we shall not have to work at all, when we shall have laid aside enough money so that we can loaf to our hearts' content. Nothing to do, no responsibilities, life will be very much like heaven as the old Sunday-school songs describe it. But as long as things are going well that kind of life, of beatific banality, either here or hereafter, has little attraction for us.

Whether we wish to or not, most of us have to work. Some of us do too little, and a few, a very few, do too much. How can we know how hard we should work? It is not a simple matter, for which a standard can be set, because people have different capabilities and different powers of endurance. To one person a certain task may be easy while to another it would be the hardest kind of labor. In fact, both to work and to labor have, each, two different meanings. The dictionary says:

Work, v. To make effort to attain anything; to be occupied in business or labor; to strain or labor.

Labor, v. To work; to take pains; to be oppressed; to move slowly.

Both work and labor may be pleasant or unpleasant, healthful or harmful, depending upon various factors: upon our interest in what we are doing and the pleasure we get out of it. Also upon whether we are accomplishing anything; because interest and pleasure are enhanced by achievement. And finally upon the presence or absence of other distractions which tend to pull us away from our task, to cause us to strain and labor.

An instance of such a distraction is occurring at the very moment of writing this chapter. It is a gala day outside. The city is dressed with flags and bunting. Bands are playing and the crowds are cheering. Down on the street a great parade is going by, soldier and civilian organizations; nearly everybody is either marching or on the side lines as a spectator. Distraction everywhere. Writing at this time is not only to work but it is to labor, to move slowly, to be oppressed.

Any kind of work, physical or mental, pleasant or unpleasant, causes fatigue; and to be tired afterward is perfectly normal, even to be very tired if the languor and lassitude disappear after an interval of rest or a change of occupation. It is only when the uncomfortable sensations persist from day to day, when one awakens tired and goes to work spiritless in spite of a night's sleep, that one may be said to have something wrong with him.

Overwork usually means one of two things—either too long continued effort or effort misdirected. Hard work of itself never injured anyone when taken in proper doses. The fatigue which comes with it can be overcome and one's natural buoyancy restored. Physi-

cal work and mental work are analogous in their processes and in their effects upon the body. Both are forms of physical activity, one expressing itself in the movements of muscles and the other having its principal seat in the brain. Thoughts are just as much a form of energy as are muscular contractions. In the production of both, tissues are consumed and waste products formed. It is the accumulation of these ashes and gases of combustion which causes all the symptoms of fatigue. That it is very largely a matter of chemistry has been proved many times. Scientists have introduced a small quantity of the blood of an exhausted animal into the circulation of one that was perfectly fresh, and have reproduced the languor and exhaustion in the fresh animal.

The two most important chemical compounds formed are carbon dioxide, a gas that remains in the tissues until carried off by the red blood corpuscles to be eliminated, and lactic acid. Tired muscle contains an excess of lactic acid. Injecting a dilution of this acid into a healthy muscle will weaken its contractions, and a larger amount will stop them altogether. The presumption is that it has a similar inhibiting action upon the brain. Not until the excretory organs have removed the excess of these waste products is the normal condition restored.

If one is constantly tired, not lazy or indolent but actually tired, it is because his production of these poisons exceeds his power to get rid of them. But one may become fatigued if he overuses certain muscles only, while other groups are passive; and also if he uses certain brain centers alone while the others remain idle. For this reason rest may be brought about by changing the direction of one's energy. Brain workers

often achieve it merely by directing their thoughts into other channels, by taking up another kind of mental activity; and athletes avoid fatigue by changing the form of exercise. The man in training works a while with the wall machine, punches the bag a few minutes, uses the parallel bars, wrestles, and finally walks or runs a mile or two in the open air. For the same reason mechanics play games during lunch hour. All morning they have been using certain muscles and at noon these are rested while those which have been dormant are active. The best way to rest by change of occupation is to make the change complete. If the brain is tired, physical exercise is the best antidote. It quickens the movement of the blood stream, increases the capacity of the lungs, stimulates the activity of the sweat glands and kidneys and, what is of equal importance, it directs the mind toward a pleasurable occupation.

The pleasure we get out of a job has a great deal to do with its effect upon us. Interesting work is not nearly so tiring as that which is uninteresting. This is largely because it is easier to fix one's attention upon the former and almost impossible to keep the mind upon anything disagreeable.

No matter how simple a task may be, a certain amount of brain work is required for its performance. There is no purely physical effort which does not necessitate the use of more than one muscle. Usually many groups of muscles are brought into play and their coördinate movements are affected through the brain centers. The more complicated the movements the harder it is to learn the coördination necessary to perform them properly. Learning to play the piano is an instance of this difficulty. It cannot be accomplished

until long and laborious practice has finally made well-worn paths between the various nerve centers in the brain. Later the movements become almost automatic, but for a long time each separate act is accomplished only by fixing attention upon it. And attention cannot be held long without fatigue, especially if there is no pleasure in the thing itself. It is almost impossible to learn anything very complicated if one gets no pleasure out of it or can see no reason for learning it.

One who has no interest in what he is doing very quickly becomes tired. It is a well-known fact that prisoners have an exceedingly limited capacity for work on this account, and if they are forced beyond their very meager limitations they soon begin to show signs of exhaustion.

A boy will play hard all day at the most strenuous games, but if he is put to sawing wood his powers of endurance are soon dissipated unless he has an incentive, a reward of some kind to which to look forward when his work is done. If he knows that he will get money with which to buy a ball or bat, or to add to his fund for a football outfit, the knowledge will add tremendously to his vitality. If he realizes that he can go swimming or play with the fellows after he is through, his celerity and eagerness to work will be almost alarming.

We are inclined to be somewhat cynical regarding this characteristic of the young, but we grown-ups have it as well. The difference lies merely in the fact that the ends we desire to achieve are usually more remote. In our case they are power, recognition, wealth and the ultimate chance to do what we please, while children look but a few hours ahead.

One thing that lessens interest is monotony, having

to do the same thing day after day in exactly the same way. Whether they are mechanical or mental, such occupations eventually produce torpor, stagnation, lack of ambition and incentive. The bookkeeper or bank clerk, the mother of a large family who is constantly occupied with house work and the care of her children, the man at a machine, the shopgirl doing piecework—all of them must have resources within themselves. All of them must have an occasional change, something else than their work to look forward to, or they are in danger of becoming mere automatons. Their intellectual centers will become atrophied and the lower centers over-developed; after a while they will be utterly unfit for any other kind of work than that which they have so long been doing. Even in that particular work their efficiency will gradually lessen and fatigue will appear from slighter causes.

Another cause of fatigue lies in the emotional sphere. Everyone has noticed how little he can do when he is worried, without becoming tired. We worry when things are going badly, when our purposes are being frustrated or their ends delayed. For instance, you have a certain amount of work which must be done in a given time. In order to accomplish this you must give it your closest attention, the greatest mental concentration. You go to the office, confident that you will get through with it. Then there come interruptions and distractions. Someone comes to see you on business that could easily be postponed, but you do not like to offend him; it would not be politic. A friend from a distance drops in to chat because he happens to be passing through the city. You like him and would be glad to see him if you were not busy. Half a dozen unnecessary telephone calls break into your

morning. Still you struggle on, because you are getting further and further behind your schedule. Finally a subordinate comes in timidly to say that he is sorry to interrupt, but—and tells you about something wrong with the business.

You go home that night with nerves on edge, exasperated, utterly worn out. The chances are that you will sleep badly and awaken tired.

Our work may be harassing for other reasons also, reasons that exist within ourselves. If we have not learned just how to do a thing, if we lack skill, we make many false moves and we suffer from lost motion and exasperating delays.

Or we have habituated ourselves to attend to small details that should be delegated to others. The performance of these unnecessary acts not only consumes a certain amount of energy in itself but retards the progress of larger, more important enterprises. Some business men need an efficiency engineer more than they need medical advice.

A friend put his finger on the trouble of a very nervous business man recently when he said: "You waste a lot of time in answering the telephone. Why don't you let other people do that? You've had five calls in the past half hour, and only one was of the slightest importance." Did his remark have any effect? Probably not, because a habit of long growth cannot easily be changed.

A third element in fatigue production has to do with physical conditions about us, in office or shop or store; chiefly bad air and bad light. Of these much has been said in previous chapters and it will suffice merely to emphasize that by their effect upon the health they lessen endurance.

But no matter how much interest we have in our work or in the ends to be achieved, no matter how many different things we are doing or how much pleasure we get out of doing them, after prolonged application we become fatigued. Attention lags, efficiency is lowered, and a night's rest does not restore them; or at least they do not last throughout the day. Then it is time to take a rest, and the sooner we get it the better. The longer it is postponed the more time will be required to recover the old resiliency of mind and spirit.

If we go on working in spite of growing languor and lassitude sooner or later we shall become stale. The athlete knows what staleness is, and he knows that the only thing to do is to stop all training for an indefinite period. Staleness comes to the brain worker as well as to the athlete, and its manifestations are quite similar.

The symptoms of chronic fatigue are more than a mere tiredness that remains day and night. They are various in character and variously located; chiefly in the head, the muscles, the digestive organs. Nearly always there are loss of appetite, coated tongue, sluggish digestion; the muscles may be sore, there may be pains and uncomfortable sensations in different parts of the body; also frequent or continuous headache and often confusion of mind, inability to think consecutively. It takes considerable time and persistence to become stale. And recovery usually takes at least as long.

The final breaking point can be avoided, however, if heed is given to an early warning, the gradually lessening ability to work. The symptoms develop very insidiously. At first the change is scarcely noticeable, merely a slowing up. There may be occasional spurts of speed, but they do not last, the reaction comes

quickly, the tired feeling grows more pronounced and lasts longer. Later it is present almost all the time. And finally, if we ignore the warning, there are other signs; ambition is lost, and mental alertness; no spur, no incentive can bring back the old efficiency.

Then it is certainly time to stop whatever we are doing and rest long enough to restore health and vigor, no matter how long it may take. To one already tired even very slight additional work increases the fatigue out of all proportion. No good can be accomplished by attempting to go on, because by doing so the breaking point will be advanced rather than retarded, and when it comes the wreckage will be more complete.

One reason for this is that anything attempted when in a state of chronic fatigue is much more difficult of accomplishment. We struggle against this inability to do what we have formerly done easily, and the constant struggle adds tremendously to our handicap. Adverse emotions are awakened, worry, irritability, anxiety, exasperation; all of which are as harmful as their antitheses, pleasure and interest, are stimulating.

In fact, the emotions have more to do with producing excessive fatigue than all other causes combined. When work is congenial one can stand an almost unlimited amount of it and remain normal. But in times of storm and stress, when new and unexpected difficulties arise, they are apt to cause an unsettled state of mind. This in turn reacts upon the physical condition, the earliest evidences of which are languor, impaired digestion and disturbed sleep or a deep sleep resembling the stupor produced by a narcotic, from which one awakens unrefreshed.

The question of overwork, then, is not so much a matter of how much we are doing as how well we are

doing it. It may be that we are attempting something beyond our powers and therefore futilely. Perhaps, because of unsettled nerves, we are taking things too hard, worrying unnecessarily, and getting nowhere. Or there may be an underlying physical cause which should be remedied. And, finally, perhaps we are trying to do the wrong kind of work, for which either we are not suited or in which we have no interest.

As with every other abnormal condition the effects of excessive fatigue are much more easily prevented than cured. Getting rid of them is a slow process, but prevention is rather a simple matter. It requires the application of certain common-sense principles the adoption of which makes for greater happiness and also for greater efficiency. The chief requirement is the substitution of certain good habits for harmful habits.

Harmful habits are not always vicious. They may have been acquired through ignorance or indolence rather than because of willful neglect. But however acquired they are difficult to throw off.

Here is the law of habit formation: "Every time we perform a certain action, either mental or physical, or allow ourselves to be affected in any way, we have more proneness to, and greater facility in, the performance of that action or in experiencing that affection under similar circumstances than we had before."

The ease with which our ordinary habits are formed has been illustrated by the following: A man moves into a new neighborhood. His new home is in the middle of the block. The first morning on the way to the street car on the next parallel street he has the choice of going to the corner of either cross street, the distances being exactly the same. On a sudden im-

pulse, perhaps without having made any conscious choice, he turns to the right instead of the left. The next morning it is easier for him to turn to the right, and thereafter he will always go in that direction unless he determines otherwise and consciously directs his footsteps toward the left.

Children learning to speak or walk and later to play games, or older persons learning a complicated task, find difficulty at first. Later, habit shortens the routes between the brain centers. We do an accustomed thing automatically without wasting so much nervous energy upon it. In other words, habit makes movements exact, or, as the psychologists say, it "sets" them and lessens fatigue.

After we have learned by the shortened or automatic method, in order to perform a complicated act we have only to will to do it and let the mechanism do the rest. Driving an automobile is a good example. While learning we worry and fuss and make many false moves. Greater ease comes with practice and finally we become expert, we can drive just as we walk, without thinking about it. When the car skids we right it. Then perhaps someone asks: "How did you do that?" We cannot tell how we did it. The various complicated things we did to stop the skidding had been learned gradually, had become automatic, and we cannot give them in sequence without much more thought than was required to perform the act. If we had to wait to think how to avoid danger there would be an infinitely greater number of accidents.

The comparatively simple act of walking requires so many muscular movements that if we attempted to tell how we walked down street we should become as confused as the centipede:

The centipede was happy quite
Until the toad in fun
Said, "Pray, which leg comes after which
When you begin to run?"
This wrought his mind to such a pitch
He lay distracted in a ditch,
Uncertain how 'twas done.

Habits may be our very best friends or our most treacherous enemies. They govern everything we do. We can determine which we shall have by beginning early to form the right kind. Professor William James says: "Could the young but realize how soon they will become bundles of habits they would give more heed to their conduct while in the plastic state. We are spinning our own fates, good or evil, never to be undone. Every smallest stroke of virtue or of vice leaves its never-so-little scar. The drunken Rip Van Winkle in Jefferson's play excuses himself for every fresh dereliction by saying 'I won't count this time!' Well, he may not count it and a kind Heaven may not count it, but it is being counted, nevertheless. Down among his nerve cells and fibers the molecules are counting it, registering and storing it up to be used against him when the next temptation comes. Nothing that we ever do is, in strict scientific literalness, wiped out."

He means that the effects cannot be wiped out, not that we can never eradicate a habit. If habits were fixed and unchangeable it would be useless ever to give advice to another or to attempt to change one's own conduct in the slightest degree. A habit, however, can be wiped out only in one way, by the substitution of its opposite habit. We cannot get rid of indolence, for

instance, by saying, "Now I am not going to be indolent any longer." We must gradually replace it by cultivating mental alertness and physical activity.

Everything we do which affects injuriously our mental or physical health makes work harder because it lessens efficiency; inefficiency causes worry, and worry conduces to ill health—a vicious circle, out of which there is no way except by a change of habits.

The rules of health are in the main really quite simple and obvious. But obvious truths are so often ignored that they require much repetition, and for this reason a few suggestions concerning mental and physical hygiene may be of use.

If good work is dependent upon good health it is better to keep the body as nearly up to par as possible than to wait until the damage has been done. Many go on as long as possible doing things that they know to be wrong, trusting to luck or to an inherited good constitution, or at most hoping that at some future day they will have time to take care of themselves. Just now they are too busy, but then they will have nothing to do but look after their health. If that day ever comes the chances are that they will have no health to look after. A little present attention to such matters will avoid future trouble.

One of the most persistent of small habits is that of taking too little exercise. A man who has worked in an office all his life is possessed of the idea that the business cannot go on without him for a moment. Granting the truth of this in some cases, it must be conceded that there is time before and after hours that can be used to advantage.

The first hygienic rule, then, is exercise—a little every day, don't lump it all once a week. Walk to the

office in the morning, or at least part of the way. There isn't time? Get up half an hour earlier. This implies going to bed that much sooner the night before, because sleep is essential. Of course exercise is recommended to those whose occupations are more or less sedentary. Those who work at manual labor need a complete change of activity, which would better take the form of mental diversion.

If one sits at a desk all day a single dose of exercise every week or so will no more suffice than a single meal followed by a prolonged fast. A brisk walk before taking up the business of the day clears the brain and speeds up thought. Most of us confuse hard thinking with clear thinking, but the former by no means always implies the latter.

Walk part of the way home after office hours. Or if the season permits take to an outdoor game rather than to an easy-chair. Adopt a hobby; which is to say, get a good habit as a substitute for the old one of indolence. A hobby implies something interesting to do, something in which the interest carries over from day to day and grows by cultivation. A man may buy a farm, not because he expects to make a living by farming but because of the outdoor occupation it supplies for his leisure time and the pleasure he derives in watching things grow. In this case a farm is a valuable asset even though most of the bookkeeping be on the wrong side of the ledger.

Comparatively few are financially able to take up farming as a diversion. Those who have a small plot of ground at home are not badly off if they use a part of it for a kitchen garden. If the garden is worked assiduously the crop will be more than peas, beans and radishes.

If you put into the ground sufficient sweat, you will get out of it for your personal use a large amount of health and efficiency. And somewhere in the garden you will lose your brain fag.

There are many healthful forms of exercise, and the choice must depend upon the opportunity of each individual; but the essential thing is to get it regularly and as often as you can. If you live in a big city there are gymnasiums and bowling clubs and swimming pools. The only difficulty about availing oneself of these diversions is in the beginning. It is hard to start, but in a very short time a good habit is formed and there is no trouble keeping it up.

The next rule of health is—don't take business home; leave it at the office. This can be done in spite of many opinions to the contrary. Especially, don't take worries home, because they grow when carefully tended. Very often a difficulty which seems great at close of office hours will shrink if left alone, because the next day it is attacked by a rested mind. Another reason for this rule is that worry lessens the appetite and retards digestion. One way of getting rid of fatigue is by supplying food, properly digested, to take the place of tissue that has been used up in the day's activities.

Worry also interferes with sleep. The exhaustion which we think comes from legitimate work is often due to disturbed sleep, brought about by lack of exercise, indigestion and the habit of making bedfellows of our worries.

Worry and the habit of haste are more potent causes of digestive disturbances than the kind of food we eat. Imperfect mastication is a fault common to a very great majority of people. We rush through

breakfast in our hurry to get to the office, we rush through lunch in our haste to get back to work, rush through the afternoon, rush home, and do not know how to slow down when we get there. Cultivate the habit of eating slowly. Gladstone achieved it by fixing the number of chews to each bite, thirty-two. This was purely arbitrary, but it was his method of obtaining the desired result.

All the other rules of health are just as simple, just as obvious, and by most of us just as little observed. They have to do with states of mind as well as with purely physical conditions, because of the intimate relation between the mind and the body.

Take the habit of pessimism, for instance. If the body is out of sorts one becomes pessimistic. Many dyspeptics excuse their crabbedness and irritability on the ground that they are not well. But often the beginning of a physical disorder is a state of mind. One who suffers from melancholia almost invariably has a coated tongue and other signs of digestive disturbance.

Mental habits are even harder to overcome than those which are purely physical. But, as with the latter, the former may be conquered by the law of habit, which is the law of contraries. They can be supplanted by their opposites—pessimism by optimism, irritability by placidity. Happiness is one of the corner stones of good health, and so is contentment. Without them neither physical nor mental efficiency attains its maximum.

No matter how congenial our work may be and how efficient we are, somewhere in the minds of all of us lurks the ambition to have nothing to do. Some day, we assure ourselves, this mad rush will be over and we shall "loaf and invite our souls." The desire is

not always uppermost, but it is there nevertheless. It provides the incentive to struggle hard in order that it may be gratified. But we must not allow it to dominate us or we run the risk of seeting too rapid a pace and of breaking down before we have reached our goal.

In the meantime, however, during the long years of striving, habits of work are formed that we cannot easily tear from us; we become set, no longer plastic; it is difficult to change without breaking. In fact, with some it is impossible.

Of two men of the same age, both healthy, life-insurance experts consider the one who retires from business the worse risk. He has less expectancy of life. Actuaries estimate a man's expectancy at two-thirds the difference between his present age and eighty. At sixty the average man will live thirteen years longer, or until he reaches seventy-three, provided his present health is good. But the expectancy of the average business man who retires at sixty is not so long, although the exact amount by which it is shortened has not been accurately estimated.

Some of the large railway systems retire their men at the age of seventy. The rule applies to officers as well as to the others and has no regard for health or vigor of mind. Not invariably but so commonly as to be expected, very soon after his retirement a man begins to slump. "He is getting the pension look," his friends say. His mental alertness deteriorates, he slouches in gait and posture, even his face shows the change. His only salvation is to find something to do and to do it.

Sudden stopping of physical occupations has the same effect. A good example of this was recently

observed by a physician to whom a man and his wife had come for advice. A thorough examination brought out many physical and mental disturbances—among them indigestion, coated tongue, loss of appetite, nervousness, insomnia, irritability of temper. He was at a loss to account for them, especially as the symptoms were so similar in both patients, until close questioning brought out the fact that they had recently changed their mode of living. All their lives they had lived on a farm, each working hard, without other help. Then they had struck oil, acquired sudden wealth and had moved to the city to live the life of ease to which they had so long looked forward. The physician's prescription was—go back to the farm.

So far we have been discussing how much work we can do without injury and how best to conserve our energies in order to do it. But there is another viewpoint from which to discuss this question. To some it means, How little can I do and get away with it? Unhappily the number of those who so construe the query seems to be growing rapidly. Someone has said that the trouble with the world nowadays is not the spirit of unrest that is abroad so much as the spirit of rest.

Those who hold this faith make the mistake of thinking of the world in terms of themselves rather than of themselves in terms of the world. But even if one's individual welfare were of paramount importance it cannot be attained by minimum effort. Neither body nor mind can be run on low gear to advantage. Health and vigor of both can be attained only by keeping the speed just within the limits of safety. Less than this means perfunctory work, perfunctory work

soon grows monotonous, and monotony is deadly to body and soul.

When we have nothing to do the mind turns inward, we magnify small symptoms until they assume abnormal size and we become anxious, nervous, apprehensive, pessimistic. These emotions have their legitimate reaction upon the body and the result is real, not imaginary illness. When we are busy we have not time to observe ourselves too closely, our minds being occupied with important things. The same truth applies to our attitude toward external things. The busy, healthy man is happy, he does not look at the world with a jaundiced eye. But idleness breeds social unrest, it fosters the creation of imaginary wrongs and class hostility.

How hard should we work? The great majority of us do not work hard enough. Professor James put it very well when he wrote: "Men, as a rule, habitually use only a small part of the powers which they actually possess and which they might use under appropriate conditions. The human individual lives far within his limits. . . . His life is contracted like the field of vision of an hysteric subject, but with far less excuse, for the poor hysteric is diseased while in the rest of us it is only an inveterate habit, the habit of inferiority to our full self, and that is bad."

FOURTEEN

YOUR NERVES AND YOUR JOB

"Suppose that this here vessel," says the skipper, with a groan,
Should lose her bearin's, run away and bump upon a stone;
"Suppose she'd shiver and go down, when save ourselves we couldn't!"
The mate replies,
"Oh, blow me eyes!
Suppose agin, she shouldn't."

TWO men work in the same office in positions of trust and similar responsibilities. In order to distinguish them one from the other, and also as indexes of their mental characteristics, we shall call them Weeks and Wells. They are both hard and conscientious workers, but in other respects they differ widely.

Wells takes everything—petty details as well as important matters requiring decision and judgment—as part of the day's work. Nothing ruffles him. He goes home at night reasonably tired but having the pleasant consciousness of a day well spent.

Weeks, on the other hand, is known as a fusser. The least untoward incident is likely to throw him off his balance. There are days when even the ordinary routine upsets him, and on these occasions he is given to forebodings concerning the business, his own future, and in fact any subject that comes uppermost in his

mind. At the end of office hours he is nervous and irritable. Many things have gone wrong with him, and most of them he charges to the incompetency of others. When he get home Mrs. Weeks expects him to be irritable and faultfinding, because it is his usual mental state. He has had to curb his feelings to a certain extent all day, but now he can explode. Indeed on rare occasions when he does not, when he is at least passive if not actually amiable, she wonders vaguely what is wrong and whether he is ill. She is as apprehensive as Mrs. Wells would be if her husband were to storm and fuss as Weeks does in his ordinary moods.

What is the difference, or rather, what are the differences between these two types of men? They differ in temperament surely. But temperament means merely the manner in which one reacts to external impressions and to subjective sensations. By some it is called "nerves," which is even less enlightening. It does not imply that any particular nerve or group of nerves is diseased, nor that there is anything wrong with the brain or spinal cord. There are many kinds of disease affecting the brain and the nerves which one may have and yet not be nervous.

On the other hand almost any physical indisposition may cause nervousness, from serious disease to toothache or a tight shoe. There is such a close interrelation between the mind and the body that little can be said about either without including the other. Disease of the body affects the emotions, and exaggerated emotions in turn may produce a disordered physical state. One cannot be entirely happy if he has indigestion, and great unhappiness retards both digestion and assimilation. But the same degree of sickness will affect different persons differently. One will be merely less

exuberant, less buoyant than usual. Another's whole outlook upon life will be changed; he will become almost impossible to his friends. The difference is personal; it lies in the different attitude to one's emotions, whether he controls them or is dominated by them.

Some fussers seem to get along fairly well in business. Indeed a certain percentage of them live longer than those who, because of a great inward driving force, always push themselves to the limit of endurance. Weeks, for instance, may outlast Wells, because he indulges his whims. He takes holidays quite often and considers himself delicate. Precautions hedge him about much like the quills upon the fretful porcupine.

He *may* live longer, but the chances are that he will not. Violent emotions use up energy. One cannot give way to frequent fits of rage without wasting strength that might otherwise be better employed. Also they lessen efficiency, because an unhappy temperament interferes with that fine adjustment to one's surroundings that makes a smooth-running machine. On his bad days Weeks throws the whole office force out of gear and comes home exhausted, but with enough misdirected energy left to disrupt his entire household.

There is a man in the same office with Weeks and Wells whom we shall call Doolittle. Weeks is afflicted with an hypertrophied emotional nature. Wells has his days of depression as well as his days of elevation, but in spite of these he goes steadily on, smoothly, efficiently, purposefully. Doolittle, however, seems to have no emotions whatever. He appears to be entirely contented with his lot; he is a plodder, without ambition or incentive. It can be predicted of Doolittle that he will stick to his job. He will be doing the same

thing in the same way twenty years from now. He represents the other emotional extreme; he never has violent outbursts of rage or periods of great happiness. With him life is a dead level. The only change Doolittle will make will be when, as he gets older, the firm gives him a job carrying less responsibility and less pay.

Temperament is very largely dependent upon three factors, one of which is heredity. Some people are born with nervous tendencies and others are so unemotional as to be called phlegmatic. Another factor which influences temperament is early training. It would not be extraordinary, would it, if Weeks' children should acquire his unpleasant mannerisms. Inheritance may be partly responsible, but no small part is due to the atmosphere of continual bickering and emotional storms in which they pass the formative period of their lives. Unless Mrs. Weeks is as wise as her husband is foolish, their early education at home will be neglected. They are not being taught self-control at the time when lasting impressions are made. The third factor is intelligence, which is the most important of all.

Mrs. Wells' house and children are well cared for, and yet she has time for other activities, time even for life's amenities. She cleans, darns, does fancywork, and still manages to go to the theater occasionally and to keep fairly well posted about the world outside.

Let us suppose, however, that Mrs. Weeks is much like her husband in temperament. Mrs. Weeks is busier than Mrs. Wells, but she never seems to finish anything. If you were to spend a day in her house you would understand why. You would see her go many times in quick succession from the kitchen to the bedroom and back to the dining room and kitchen, con-

stantly driven from task to task, always beginning something new before completing what she is doing. False moves and wasted energy! You would realize that she is the slave and not the mistress of her emotions. The doorbell and the telephone annoy her. She says they drive her almost wild. If you give her the slightest chance she will tell you her troubles in all their details, and in the telling her voice will become high-pitched and querulous. All through the day there will be lost motion, and many high peaks of emotion, by both of which energy is wasted.

To a very great extent efficiency is dependent upon energy. Now energy is partly physical and partly mental. A healthy man will do more and better work than a man of equal intelligence who is handicapped by a physical disability. The exceptions to this rule are only apparent, not real. There are men who carry on great enterprises and achieve marked success in spite of ill health, but they do so because of superior intelligence and force of character. Still, energy is largely determined by digestion and assimilation, by strength of heart and by the quality of the blood which supplies the tissues.

In choosing a man for a job, among the requisites sought should be good health. Ill health is distracting; its influence upon thought and judgment is profound. Also he should not be too emotional—much irritated by slight occurrences or easily depressed. Because of the effect upon emotions, if possible his home conditions should be reasonably pleasant, so that he may be free from extraordinary worries. Still, if he has equanimity this need not be a barrier to his acceptance. He should be reasonably sure of himself, not too modest, not too self-confident.

Possessing all these qualifications, the final and most important requisite is the ability to learn, which is intelligence. It is in intelligence that men differ most. These differences are not always apparent, because we confuse intelligence with knowledge. The one is inherited; it is a matter of brain cells and their grouping, in which no two persons are exactly alike. The other is acquired. A certain amount of intelligence is necessary in order that we may accumulate knowledge, but in some cases it seems to need very little.

Intelligence has been likened to a machine, and knowledge to the raw material. Even a comparatively low-grade mind can acquire knowledge, but it takes one of high grade to use it to best advantage.

We can all remember at least one prodigy of our school-days, the boy or girl with an almost uncanny capacity for acquiring knowledge. They got their lessons by rote and recited them when called upon in class without omitting a single word, hardly missing the punctuation. At examinations they received high marks, and were objects of envy of all the others. Great things were predicted of them by the teachers. But somehow or other they didn't size up so well among the students, who knew more about them in their other activities. And after leaving school they dropped almost completely out of sight. They had plenty of knowledge but not enough intelligence to apply it. Such a person is like one with an enormous appetite and capacity for food but who lacks ability to transform it into tissue.

In respect of intelligence one fact is absolutely certain, belief to the contrary notwithstanding. All men are not born equal. Orators on occasion are wont to

declaim that they are, and certain radical political sects hold to it as the very foundation of their creeds. But all the laws that could be formulated cannot make men equal.

Opportunity has a great deal to do with success, but there are those who have much of it and yet fail, and others whom neither adverse circumstances nor poverty nor ill health can keep down. The truly great ones of the earth overcome all handicaps and reach the topmost level. Beneath them are many substrata of those who will not rise no matter how much fortune favors them.

We all recognize this fact in specific instances. We know that Jones is a good bookkeeper but that under no circumstances could he have fitted himself to be President of the United States; that Smith is a mediocre lawyer but no amount of training could have made him a success as the manager of a big industry, a job which requires vision, force and the ability to handle men.

These isolated facts concerning human intelligence have been universally if rather vaguely recognized, but it remained for the science of psychology to formulate them into law. During the first half of the last decade systematic studies of mentally defective children were begun almost simultaneously in France and in America. Later these investigations were extended to groups of normal children.

Certain mental tests were devised and improved until at the present time they are fairly standardized. In thousands of instances in both countries their accuracy in determining the mental capacities of children was proved.

And then came our entrance into the war and the

mobilizing of our young men. Millions of them had to be classified mentally as well as physically in order that they might be so placed that they could be of most service to their country. Very soon at every camp there was not only a medical examining board but a group of psychologists. More than 1,700,000 were tested for their intellectual abilities and classified. Neither knowledge of warfare nor previous schooling had anything to do with their grades; the tests were based upon intelligence, the ability to learn, to understand orders and to carry them out.

Uniform sets of test questions were given out and the men were graded according to the number of points made in the examinations, the grades being A, B, C plus, C, C minus, D, D minus and E, or eight in all, of which A was the highest and E the lowest. In the examinations the highest number of points obtainable was 212, but as low as 135 points placed a man in the A grade. The B's were those who scored from 125 to 134 points, and so on down to those of the D minus and E grades, who scored less than fifteen.

These examination questions were not of the ordinary kind, based upon book knowledge; they were devised to bring out a man's ability to perceive, to comprehend, and to exercise his judgment. A few of the simpler questions are given here in order that this fact may be understood:

Are cats useful animals because they catch mice, or because they are gentle, or because they are afraid of dogs?

Do these two words mean the same or opposite: Wet—dry?

Rearrange each of these groups of words into a sentence and tell whether it is a true or false statement:

Lions strong are.
days there in are week eight a.
leg flies one have only.

Write the next two numbers in this series:

3, 4, 5, 6, 7, 8.

In this series:

15, 20, 25, 30, 35.

From the four words in heavy type select one that is related to the third word in italics as the second is to the first:

gun—shoots : : knife—run cuts hat bird

Each question was fully explained and the men had ample time to finish the examination. No one was rated D minus who answered correctly any fifteen questions of the list.

Under Explanations of Ratings the report of the Surgeon General states:

"The rating a man earns furnishes a fairly reliable index of his ability to learn, to think quickly and accurately, to analyze a situation, to maintain a state of mental alertness, and to comprehend and follow instructions. The score is little influenced by schooling. Some of the highest records have been made by men who had not completed the eighth grade. The meaning of the letter ratings is as follows:

"A. Very Superior Intelligence. This grade is ordinarily earned by only four or five percent of the draft quota. The A group is composed of men of marked intellectuality. A men are of higher officer type when they are also endowed with leadership and other necessary qualities.

"B. Superior Intelligence. B intelligence is superior but less exceptional than that represented by A. The rating B is obtained by eight to ten soldiers out of a hundred.

"C plus. High Average Intelligence. This group

includes about fifteen to eighteen per cent of all soldiers, and contains a large amount of non-commissioned officer material with occasionally a man whose leadership and power to command fit him for commissioned rank."

The grades run all the way down through C, C minus, D and D minus, to E.

The immense contrast between A and D minus intelligence is shown by the fact that men of A intelligence have the ability to make a superior record in college, while D minus men are of such inferior mentality that they are rarely able to go beyond the third or fourth grade of the elementary school, however long they attend. In fact, most D minus and E men are below the mental age of ten years, and at best are on the border line of mental deficiency. B intelligence is capable of making an average record in college. C plus intelligence cannot do so well, while mentality of the C grade is rarely capable of finishing a high school course.

The conclusions were many times corroborated by experience. For example, nearly all the officers had received their rank before the tests were made and yet 82 per cent were found to be in the A and B groups. Before a certain army unit went overseas the officers rejected as mentally unfit for overseas service 306 men. Subsequent mental tests showed that 90 per cent of these men were of a mental age of ten years or under.

If we grant that the results of these army tests were even approximately accurate we are forced to the conclusion that the rest of us grade mentally about as the men did in the Army. Nearly two millions of them, from all parts of the country, from all walks of life and with all degress of education and ignorance, they

can reasonably be regarded as a standard by which to judge the other hundred-odd millions of us.

Let us see, then, how the people of this country average up in accordance with the doctrine of mental levels. Remember that children are included in this estimate, because it is based upon the attainment of or the ability to reach a certain mental development, and not upon knowledge. On the basis of 100,000,000 there are in the United States:

Of A grade, Very Superior Intelligence	4,500,000
Of B grade, Superior Intelligence	9,000,000
Of C plus grade, High Average Intelligence	16,500,000
Of C grade	25,000,000
Of C minus grade	20,000,000
Of D grade, those whose mental age is 9½ to 11½ years	15,000,000
Of D minus and E grades	10,000,000

D minus persons have the mental age of a child of ten years or less. They are not capable of advancing beyond the third or fourth grade of the elementary school, no matter how long they may attend. Those of the E group are mentally deficient. Many of them belong to that class of the feeble-minded called morons.

To go back to the army examinations for a moment, if a certain large proportion of men between the ages of twenty-one and thirty-one or over had the mental development—that is, the intelligence—of young children, is it possible that any kind of education, however eagerly pursued, would have brought them up to the B or A grade? If not, we come logically to the law of mental levels, which is this:

Every human being comes into the world with a potentiality for mental development that will carry him so far, and, barring accident, nothing can affect the mental level which he will attain.

That sounds like the doctrine of predestination applied to mundane things, and in a sense it is. However, it merely states as a general proposition what everybody knows—that we cannot all be great, measured by the same standards. Unless we deny this fundamental and self-evident truth we must recognize the absurdity of the doctrine of intellectual and social equality. If social and economic equality could be brought about, how could it be achieved? By bringing all those of the A, B and C groups to the D level, or by raising the D's to the A and B grades, or by bringing both extremes toward the middle?

If by edict and legislation this could be done, how long would it last? Probably not the span of a generation. Even in the matter of an equal division of property, it would not take long for the A's and B's and C's to get back more than their equal share.

Two fundamental truths are ignored by those who hold the doctrine of equality. One is that those of lesser intelligence are invariably guided by the more intelligent. Even a soviet government must have its leaders, whom the rabble follow with a blind faith. The other truth is that each mentality has its own standards of happiness and success, and each would suffer if raised or lowered from the plane to which it belongs. Sooner or later each would drift back to its own level.

What is absolutely essential to a healthy democracy is a widely disseminated feeling of mutual confidence. Noticeable lack of it at the present time is the cause of so much social unrest, for which the A's and B's are at least as responsible as the C's and D's.

An ideal society would be that in which every one of us had exactly the kind of work to do for which he

is best fitted; but for obvious reasons that is not possible. Many conditions may interfere; such as, for instance, lack of early education, ill health, poverty, inherited nervous tendencies, and in many cases mistaken choice of occupation.

This last is of more frequent occurrence than is commonly supposed. Even the professions have their misfits, who, through mistaken choice or because they followed in the line of least resistance, have become physicians or lawyers or preachers and have not discovered their error until too late. It is a true saying that many a good mechanic has been spoiled in the making of an indifferent doctor or preacher. It is just as true that many a poor mechanic would have done better in a profession.

A great many people do not achieve their proper measure of success because they are miscast. Struggling against the inexorable law of mental levels they attempt tasks beyond their ability; they worry and fret and ultimately break down. There are many C men in B jobs, at which they are at least relative failures.

Take our friend Weeks, for example, who stands for the nervous, overwrought, irascible type of person. Isn't it possible that he is mentally an underweight, or at least that he is not doing the kind of work for which he is best suited? Some of the Weekses are, that is certain. Some of them would better be on a farm or in a mill than in an office, encompassed about with harassing details and responsibilities.

And on the other hand there are plenty of B or A men doing C work, either because of a scarcity of the higher jobs or by reason of an inherent diffidence or on account of a combination of circumstances not

within the power of the individual to control. The law of mental levels does not predicate that everyone will achieve success or reach that station in life which he deserves. It merely states that each of us has a certain capacity for intellectual development beyond which he cannot rise. It has nothing whatever to do with our efficiency or success in life within our limitations. A person of C intelligence may be as successful in his way as the man on a higher plane. And the latter may be as much of a failure as the former.

Efficiency depends not only upon the ability to learn but upon the amount of useful knowledge we acquire. In this respect we are the masters of our souls, the arbiters of our destiny. We are like mountain climbers; some have strength to reach the topmost peaks, others can climb but to lower levels. And some of us are content to let others, weaker than ourselves, except in spirit, pass on and leave us behind.

This may be due in part to lack of ambition. But it may be due also to temperament. The word "temperament" is used here to indicate our reactions to the smaller annoyances of life; in other words, the proneness to worry or the ability to keep from worrying is an important factor in efficiency. It may be contended that this in itself is a manifestation of intelligence or the lack of it, but on the other hand worrying is largely a matter of habit, and bad habits are due to early training, carelessness and self-indulgence.

Provided one chooses wisely the things to worry about, a reasonable amount of worry is not bad. This is well illustrated in the case of Wells. Doolittle, on the other hand, does not worry at all. But Weeks

is a chronic worrier and uses no discrimination. It is usually the petty annoyances that cause the most trouble to a chronic worrier, as might easily be seen if you were to spend a day with the Weekses.

You would note that he jumps every time the office boy slams the door. He fumes because his stenographer chews gum, and watches her with intense fascination until he arrives at a state bordering on delirium. At home, in the evening, he keeps shouting at Willy to stop that constant clearing of his throat. Mrs. Weeks also has her pet aversions. She insists that Susie sit in another chair because the incessant rocking nearly drives her crazy. In this manner the pleasant family intercourse proceeds until finally Weeks jumps up indignantly and storms out of the room, saying that he cannot stand all this bickering. With each of them intolerance of little things has become a habit.

Another bad habit is intolerance of the personality or opinions of others. Some of us live in a little world of our own in which all our companions are of like tastes and thoughts, all cut to a pattern. Those who do not conform with our ideas are outside our circle.

Weeks hates Thompson because he boasts, and Robinson for his cold and distant manner. Now Thompson is a rather fine chap when you get to know him. He has a harmless exuberance of spirits and a tendency to mild exaggeration which strangers sometimes mistake for boastfulness, but he is really rather modest. And Robinson's aloofness is due to diffidence, not to indifference. Really Weeks has developed and nourished a spirit of hypercriticism that has not only made him uncompanionable and unhappy but has influenced his usefulness in business.

Another source of worry to many people is the weather. They are constantly quarreling with it. The day is either too hot or too cold, too wet or too dry. A dull day depresses them, their spirits sink, their minds turn inward, they conjure up imaginary troubles and magnify little ones. Someone has suggested that instead of fighting the weather we make friends with it. We should remember that as long as we live at least three days out of four will not meet our desires in this respect and that worrying about it is of little use.

It is the same regarding health. If Mrs. Weeks gets a slight pain or a bit of indigestion or a headache, at once she begins to think of all the possibilities that may occur. She finds it difficult to believe the doctor when he tries to assure her that nothing serious is wrong. There are people like Mrs. Weeks, who have an ideal of perfect health which they seldom attain. They do not reason that they cannot feel perfectly well all the time, and when they do not they become apprehensive.

When certain ideas become so persistent that they obtain possession of us they are called obsessions. In the strict scientific use of the word an obsession is a harmful idea, one which interferes with the orderly conduct of our lives, usually based upon a fear. Most of us have at least one or two fears which, if we acknowledge them at all, we call superstitions.

You are walking down the street with a friend when he suddenly clutches your arm and drags you toward the curb. "You almost walked under that ladder," he says, and you both laugh. But you didn't walk under it, although it would have been much more convenient than to go around. In the morning you start to put on the left shoe first when you suddenly

remember that it might bring bad luck and you take it off.

Exaggerated self-consciousness is another and more serious handicap in the pursuit of success and contentment. Nearly everyone is painfully self-conscious at times. On entering a street car, if your mind is not preoccupied, you may be suddenly aware that all eyes are centered upon you. For a second you are disconcerted. Then you realize that the gaze of the idle always follows a moving object, and your momentary bashfulness disappears.

Suppose, however, that you dread to enter a car or a crowded room, that when compelled to do so you become agitated, you tremble and blush furiously; your whole body becomes hot and suffused. Your agitation is increased by the knowledge that your state of mind is apparent to others.

If you are a victim of this morbid type of self-consciousness you have what the psychologists call erythrophobia, or the fear of blushing.

Between these two extremes there are many degrees of bashfulness, all of them more or less disconcerting at times and the more severe types positively painful. Strange to say, this failing is not based upon diffidence so often as upon an exaggerated self-importance. If we could see ourselves always in proper perspective we should not be so shy. We should understand that what we do or say, how we are dressed and the manner in which we conduct ourselves at the moment are of very much less concern to others than to ourselves.

A still more fertile source of worries is doubt. All of us have our moments of doubt and uncertainty, even about comparatively trivial matters. Night is an especially favorable time for doubts because then our minds

are not distracted by more important things. As we are about to fall asleep, or if we awaken toward morning, a disconcerting thought about an occurrence of the previous day presents itself. We wonder if we offended Jones when we addressed to him that facetious remark. It wasn't funny anyhow, and would have been better left unsaid. Or we are uncertain about that important contract, whether anything essential was omitted. Or it occurs to us that we may not have locked all the windows before retiring.

The occasional appearance of such doubts is perfectly natural. But if they continually assail us, preventing sleep and harassing our waking hours, they are becoming morbid doubts. Suppose, for example, that we are impelled to get out of bed not once but several times every night in order to assure ourselves that the doors and windows are locked. Then we should be obsessed by the folly of doubt.

The doubting folly has many phases, of which the following are instances taken from life:

A certain business man spends a precious hour or two each morning reading the carbon copies of the previous day's letters because he is afraid that he may have omitted something important from one of them. The president of a bank in a small town insists upon locking the safe and the doors himself at the close of banking hours. Then, part way home, he invariably returns and tries all the locks.

Others who have the doubting folly are chiefly concerned with the future. They are always afraid that whatever they contemplate doing will turn out badly. "Suppose," they argue, "that I should do so and so, and such a thing should occur." And so they don't do it. Sometimes their doubts are as baseless as those

of the little girl who, when asked why she was crying so bitterly, said that she had been thinking that if she grew up and married and they had a child and the child grew up and there should be another war, he might be killed.

The antidote for this kind of doubting is to insist upon thinking the opposite.

"Suppose she'd shiver and go down, when
save ourselves we couldn't!"
The mate replies,
"Oh, blow me eyes!
Suppose agin, she shouldn't."

Doubt often takes the form of argumentativeness. When the argumentative doubter is told to do a thing he can advance a dozen reasons why it should be done differently or why it should not be done at all. In this way he consumes more time and energy than would be required to do what he is told; he exhausts both himself and others.

The habit is easily acquired by the young if parents, in their desire to be fair, are willing to listen to argument upon every subject proposed. The judicial attitude toward children is proper enough, but it may be carried too far. Children, and adults also, often argue not from stubbornness but because they are in doubt about what course to pursue. If allowed to bring every act into court for prolonged discussion children are in danger of becoming chronic doubters, never sure of themselves or of others, never going straight toward a goal by the shortest route.

The ability to go straight toward a goal, however distant, is an attribute of intelligence. Provided the object to be attained is worthy of the effort, the more

difficulties that must be overcome to reach it the greater the intelligence required. This brings us logically back to the law of mental levels, which predicates that intellectually we are not all cut to the same pattern.

But granting that we cannot all be intellectual equals, that literally it takes all kinds of people to make a world, success and failure are only relative. It is also perfectly evident that, within these limitations, if one sticks to the kind of work for which he is best fitted both by intelligence and training he can be as successful and as happy in the consciousness of achievement as the fellow just a little higher up or a little lower down in the mental scale.

A few of the conditions that surround us are not within our power to change. We cannot change our ancestry or our early environment, for instance. But we have something to say about our habits, both good and bad. And among these perhaps the habits that have the most influence over our daily lives are those of worry and irritability of temper.

The habit of fussing about little things has its source in an exaggerated ego. Those who fuss will utter an indignant protest here—that is, provided they can be brought to acknowledge that they do fuss. However, they do, either consciously or unconsciously, look inward instead of outward. Their personal feelings, tastes and predilections have been magnified out of all proportion to their real importance.

Exactly the opposite state of mind—diffidence, unsureness of oneself, from which arises the folly of doubt—is the next most potent factor in retarding one's progress. This can be cured only by cultivating the ego, which is often a long and tedious process but which will eventually bring results. The best antidote for

the small worries of any kind is to take one's weakness out for a mental airing every now and then. Hold it up to the light and look at it. Compare it in all its puny insignificance with the bigger things of life. Laugh at it. Laugh at yourself.

Not long ago a successful business man was asked how it was that he could carry so many great responsibilities without showing or feeling the wear and tear. He answered in nine words, but they deserve a paragraph all their own:

"I always play the game with the white chips."

For the benefit of that small minority of persons who are not familiar with the national indoor sport it may be said that the white chips are the least common denominator of exchange in poker.

A good poker player does not give too anxious consideration to the value of the chips. He plays the game to the best of his ability, unhampered by doubts and worries. And, win or lose, after one hand has been played there will be a new deal.

In the game of life each day's hand should be played for all one is worth. If fortune does not favor to-day, don't worry! To-morrow there will be a new deal.

FIFTEEN

WHAT ARE YOU AFRAID OF?

JUST offhand, without stopping to think, you will probably say: "Nothing. Only silly, weak-minded people are afraid." But if you do stop to think you will revise that statement. You will realize that you are often afraid, and sometimes without sufficient cause. Only weak-minded, very weak-minded, persons have no fears. No, I am wrong. There is no one in the world whose actions are not governed by fear, and those who have the fewest fears need attendants to watch over them.

But there is a difference between a normal fear and an exaggerated fear, although it is not often well marked. Why do you stop at the curb and look both ways before crossing a crowded street? Because you are afraid of being run down by a car or a bus. If you did not take this precaution you would show a lack of intelligence, wouldn't you? In such circumstances some people show more timidity than others; they stand upon the pavement, hesitating, then dart across, although there may be very little danger in crossing deliberately. But if you stopped, hesitated, then walked a square farther and still failed to bring your courage up to the starting point, and finally someone had to take you by the arm and lead you across, that would be an exaggerated fear, wouldn't it?

Suppose you were afraid to cross any open space, alone. Then you would be a victim of "agoraphobia,"

or the fear of open spaces. If you have ever seen a city cat cross the street, you need no further description of "agoraphobia." You see how difficult it is to draw a line between a perfectly normal fear and an exaggerated fear. Even the possession of an exaggerated fear does not necessarily mark one as mentally unbalanced. There may be an excellent reason for it, of which the possessor is unaware. But, conscious or unconscious, it controls many of his actions.

You are about to start upon a long journey, when someone exclaims: "My goodness, you are not going to leave on Friday, are you?" Or, worse and worse, "You must not go on Friday, the thirteenth!" And so you change your plans.

On your way downtown you happen to notice a ladder up against a building, with its base far out on the pavement. No matter how worried you may be with household or business cares, you walk around the ladder, even going out to the gutter, if necessary, to avoid going under it.

One day, when a friend of the family is calling, you notice that he appears nervous and fidgety. His conversation is jerky, and he moves about from place to place in the room. Finally, in desperation he tells you the reason: He is afraid of the cat, the family cat, the children's pet. With a tolerant smile you put the cat out, and all is serene. You realize that your friend has an exaggerated fear, but you do not think that he is insane.

I know a surgeon, fearless in his profession, a man who in emergency has operated on his own child without a tremor. And yet he cannot endure the sight or even the thought of maggots, the larvæ of flies.

Most of us who are afraid of rats or of snakes smile

in a superior way at the woman who jumps upon a chair when a mouse runs across the floor. Wherein lies the difference? Some aviators who like to fly thousands of feet above the ground are unable to look down from a high building without great mental distress. Many perfectly sound and healthy persons go about their daily tasks absolutely convinced that they will die of cancer, and no amount of reasoning or argument can obliterate their terror of it.

There is hardly anybody in the world who has not some particularly aversion or fear. It may be argued that the disinclination to leave home on Friday or to walk under a ladder is only conformance to a superstition; but if we conform to the superstition it is fear that makes us do so, however much we hate to acknowledge it. Everyone who possesses an absurd fear realizes its absurdity, but neither persuasion nor ridicule can rid him of it. The fear remains and cannot be entirely obliterated.

The reason for this is that the cause lies much deeper than the trivial incident, or object, or idea, which brings the fear to the surface of the mind. It has its roots in an early experience which our hereditary instincts and certain curious, hidden, unconscious mental processes have perverted or exaggerated. In order to understand the matter we shall have to learn something about fear itself, what it does to us and what it does for us.

Once upon a time, so those who believe in evolution tell us, very shortly after we had evolved from primordial protoplasm, millions of years before we had brains or even spines, in other words, when we were invertebrates, it did not affect us much if we lost parts of our bodies in conflict or by accident,

because we had the power of reproducing them. Not having much ability to defend ourselves, our very existence depended upon the amount of injury which we could make good by regrowth. As we grew up in the scale of existence and became better able to defend ourselves, this regenerative power gradually disappeared, because it was less needed.

Whether you believe the theory of evolution or not makes little difference in this argument, because you can see the power of regrowth in lower animals. Reptiles replace fangs that have been lost, and crabs and lobsters sprout new claws very soon after battle. Now, we cannot grow a new leg or a new arm if we have lost it, but we are better able to protect ourselves by forethought and by our ability to avoid danger or to overcome it. And we have also a defensive power which the lowest orders of animals do not possess. We have it in greater degree than any of the animals, but we do not always treat it with the respect it deserves; we rather look down upon anyone who has it more than we have. It is called fear.

In fact, we are often ashamed of it because we think it a sign of weakness; whereas fear is really a beneficent, protective mechanism given to us as a safeguard from harm.

There are two kinds of natural fear, instinctive fear and conscious fear. Instinctive fear is the kind which we see so often in the lower animals. Newly hatched chickens run to their mother at the sight of a hawk even before she has given the warning signal. Young dogs will bristle and growl at the sight of a wild animal or even at its pelt, although nothing in their experience can have taught them either fear or antipathy. Such instincts have the obvious purpose of preserving

life and are handed down from their wild ancestors. Very young children have instinctive fears. Nearly every mother has noticed that her baby shows a fear of falling, although it may never have fallen.

Even those of us who are grown up, with fully developed powers of reasoning, have instinctive fears, and we often give expression to fear in ways that are similar to those of animals. This is especially the case when something utterly new and sudden alarms us, because we are not prepared and can put up no other defense. For the same reason, those who are in positions of great danger from which they cannot escape are apt to display fear.

During the war soldiers were so frequently placed in such circumstances and had to endure them so long at a time that it is small wonder that some of them succumbed to terror. One of the reactions to fear is anger, which is spent upon the object feared; but if you cannot see the object your terror becomes all the greater. For weeks on end our soldiers did not see the enemy, and yet the enemy shells were bursting all around them, tearing great craters in the earth, burying them beneath walls and ramparts, destroying their companions.

The normal reaction to the fear would have been to go out and destroy the enemy, which conditions did not permit them to do. Often they did not have even the shelter of a dugout. They had only to wait and wait during long periods of inaction, which increased their mental strain until finally the breaking point came and they suffered from the peculiar complex of symptoms which was called "shell shock," a real condition, although it affected the mind and not the body.

When fear increases and becomes terror it has many

physical manifestations. The heart beats wildly or it may fail to act; a pallor overspreads the body; the breathing is labored, the wings of the nostrils dilate and contract; there is a convulsive tremor of the lips; the eyes are fixed and staring, the pupils dilated; the hands alternately clench and open, and somtimes the arms are extended as though to war off danger. Often the muscles are rigid and tense, the body assumes a crouching posture, there is a cold sweat and the will itself seems paralyzed. At other times there may be an irresistible impulse to flee.

Curiously enough, we nearly always refer to the region or part of our body most affected by the fear. We say: "I am not afraid, but my stomach is." Or, there is a feeling of weight in the chest because the heart is beating wildly and laboriously. Fear so often affects the heart that it has given rise to a very common expression. One says of a coward that he is "faint-hearted." "Faint heart ne'er won fair lady" does not mean that the man with a weak heart cannot get a wife; it indicates timidity. Many a man who has failed to meet a situation requiring boldness has said afterward that he had been determined to face it, but his legs had run away with him.

Now, many of the manifestations of fear belong to the lower animals as well as to man. The frightened cat assumes a crouching attitude and the dog bristles. When we are terribly afraid we have the sensation, at least, of our hair standing on end. It is not cold alone that gives us goose flesh or creepy-crawly sensations. They are also caused by terror. Most of these instinctive manifestations of fear are given us for the purpose of protection, but there are others which have no beneficial action. Fear may stimulate thought and

activity, but it may also paralyze them. It may even wipe out consciousness itself. Fear will affect the appetite and all the processes of digestion.

Many of our natural fears are based upon our higher intellectual processes, as for instance upon memory or a well developed imagination. These are just as normal as our instinctive fears. We fear injury because we have been injured; we fear danger in battle because our reason tells us that to go into battle will expose us to injury and death.

We have also other intellectual faculties, moral forces which counteract our normal fears and which lead us to do things that we know to be dangerous, to hazard injury and possible destruction. The great and strong of this world fear as much as the weak, but fear is held in subjection by will. Man has always been beset by fears, but as he has struggled upward to higher planes he has become more and more emancipated from this long oppression.

It is almost invariably the unknown which causes great fear. Mankind is a curious mixture of fears and bravery. A brave man on the ground may be timorous in the air. An aviator may fear the water and not dare to face the dangers of the ocean. A soldier may fear smallpox which has no terrors for a physician. To everyone his own fear; to everyone his own courage.

Everyone who conquers a fear gains new courage. Just as physical exercise strengthens the muscles, so each new moral conquest strengthens the will and the desire to conquer further. Finally, the overcoming of a fear begets a love of the fear itself, and gives it a fascination for the strong.

But in sleep, when our higher intellectual faculties are submerged and we become merely automatons, our

instinctive hereditary traits, our primitive tendencies, which we usually keep in subjection, come to the surface. We start, we scream out from imaginary terrors because we have no self-control in sleep. One reason for this is that although with us night is the time of the greatest shelter and safety, with our ancestors night was the time of the greatest danger. They slept very lightly and started at the slightest sound. Even in daytime primitive man was subject to sudden terrors because he knew nothing of the laws of nature, and anything new was considered dangerous and terrifying.

Up to the present we have been considering only normal fear, which was vouchsafed us as a defense. Any form of fear which is not protective, but helps to injure or destroy us, is called a morbid fear. Such fears are the unreasoning ones which are often entirely out of proportion to their inciting causes. They are called technically "phobias," and take on many and varied forms. A few are indicated in the beginning of this article. Each has its own scientific name, which is a compound of the Greek word which is the name of the thing feared, and "phobia," which is the fear itself. There are more than one hundred and fifty phobias to which people are subject. There are "acrophobia," for instance, which means fear of heights; "agoraphobia," fear of open spaces; "claustrophobia," a fear of being shut in, and even "erythrophobia," the fear of blushing.

If you have one of these phobias you will realize by this time that you are not in a class by yourself. You may be sure that many other people in the world have your particular fear. And not necessarily weak-minded people either. The strongest mind has its weak spots. Some of the greatest men of history have

been what might be called "phobiacs." A great British general, the hero of many campaigns, who often had braved death in battle, was terribly afraid of cats. So you see your hypothetical friend mentioned in the beginning of this article, in deference to whose aversion you put out the cat, is in very good company. King James I fainted at the sight of a naked sword, and Peter the Great could not cross a bridge without suffering from nausea and cold sweat, or goose flesh and tremors, or some of the various manifestations of a great fear.

Instead of objects some of us fear abstractions, such as becoming insane, being buried alive, dying of cancer or of consumption. Now these fears do not always trouble us with the same intensity. Overwork or great mental strain, especially when they cause loss of sleep, will increase them to greater proportions until they may become obsessions. Then, as the mind recovers its vigor, the fear fades again into the background.

Not long ago a man of brilliant achievement in the business world said to a friend: "For several months I have been terribly afraid of becoming insane. Day and night I have seen insanity just ahead of me. I am in constant fear of overtaking it." Several months later he said to the same friend: "I am not afraid of insanity any more, because I have caught up with it and passed it."

His language, of course, was symbolic, but it described a real condition of his mind. At some time or other in his life there had been created a fear that he would become insane. While he was otherwise mentally normal this fear was in subjection, probably appearing only in dreams or as an idea of little importance, easily put aside and forgotten. But when busi-

ness worries and long-continued mental strain had undermined his mental powers, the fear assumed immense proportions, towering above and dominating all his mental faculties. Then, as his business cares diminished and his mind regained its vigor, the fear receded.

Some time in his life, probably in early childhood, there had been an experience which had made a lasting impression upon him. Perhaps a member of his family had been insane. It is possible that in his impressionable period the fear had been implanted by his overhearing a discussion of insanity in the family, and that his mind had received a shock from which he had never recovered.

Whether you fear cancer or cats, bridges or blood, insects or insanity, you may be reasonably sure that the origin of your phobia was an experience or impression in early childhood which left a scar. If you will search your memory you may be able to trace back to a fright, an incident, a tale, a threat, something or some combination of things, that left its imprint upon your childish mind. But whether you can recall it by any conscious effort or not, the fear undoubtedly arose from an early experience, even though the recollection has been obliterated. Heredity also may be an indirect cause. One may inherit a nervous, high-strung, impressionable temperament, but the direct cause lies in experience.

Every victim of a phobia is ashamed of it; he knows that his fear is foolish, and yet he cannot control his emotions. Reason with himself as he will he cannot get rid of it, because the origin of his fear lies partly in the unconscious mind.

This brings us to the two individuals which are in every one of us. You remember the four Johns of

"The Autocrat of the Breakfast Table." There was first the John whom other people knew; then there was the John whom John himself knew; there was the John as he wished himself to be known; and finally there was the real John. Now a psychologist would divide this real John still farther. He tells us that we have two minds, the conscious and the unconscious. We know a lot about our conscious minds, but we know practically nothing about our unconscious minds.

Before we go any deeper into this deep subject of the unconscious mind, perhaps we would better clear up a possible misunderstanding of the word "unconscious." In the ordinary sense, a man who is unconscious is entirely oblivious of his surroundings, of any emotions, pleasant or unpleasant. But in the sense in which the psychologist uses the word, unconscious means "not aware of." He tells us that we have thoughts of which we have no conscious knowledge, which we cannot call up or become aware of by any effort on our own part, but which nevertheless largely control our conscious thoughts and actions.

And he further subdivides the unconscious mind into two. If we keep on we shall have John so fragmented that we shall never be able to put him together again. But let us go this once with the mind analyst as far as he wishes to take us. We have, then, the real John, made up of John the conscious and John the unconscious, and we are about to separate the latter into two. Our dissector of minds says that John the unconscious is made up of the preconscious mind and the unconscious mind proper. Let us try to understand what he means by this.

The preconscious mind is the reservoir of all our thoughts that lie just beneath the surface of conscious-

ness. They cannot be brought to light by any effort on our part, but may be by association. Here is an example: You are trying to recall to memory a friend of your early days, but every effort is vain. Neither his name nor his appearance can be evoked. One day you are approaching the scenes which were associated with him, when suddenly, before you have reached the place, before you have come to one single familiar haunt, up pop his name and his features, and he stands before your conscious mind, visualized, a reality.

There, in your preconscious mind, these thoughts have lain for years, ready to come up, but it required something outside of yourself to recall them. That much for the preconscious mind; now we come to the unconscious mind proper.

Far beneath the preconscious stratum lie the unconscious thoughts, those of which we are not aware, and which cannot be brought into consciousness by any effort or by association. It seems a bit paradoxical to say that we have thoughts which we do not "think" in the active sense, but we have, plenty of them. It will be clearer if we say that we have impulses, desires, wishes unfulfilled, predilections and aversions that have never been formulated, and of which we have never been more than vaguely aware. They are instinctive, egoistic, selfish, and have been repressed by our growing conscious mind because they are in constant conflict with our gradually acquired ideas regarding our relations to external things. They are not immoral, they have no standards of morality; they are unmoral and hence we unconsciously repress them.

This unconscious repression has an analogy in the conscious mind in our ability to "forget" things which have unpleasant associations. Why will an honest

man, for instance, forget to pay a debt and yet remember all his own debtors? Not by effort of will surely, because one cannot forget in that way. The more one consciously tries to forget anything unpleasant the more it sticks up like a sore thumb. You "just naturally forget" it; it sinks of itself beneath the stratum of your conscious mind.

What has all this to do with morbid fears? Let us take "a case," as the doctors say, and see if we can find out by analyzing it. Here is a young man with a simple phobia. He is otherwise perfectly normal, but he has a haunting fear, the name of which is "acrophobia." He cannot stand upon even a slight elevation without great mental suffering. Merely the idea alone fills him with terror, and his dreams are largely made up of falling. When he stands upon a high place his fear is greatly increased if there happens to be another man near him, because he is afraid that he will be pushed off by a man, not by a woman.

Finally, the fear getting beyond his control, he does the wisest thing: he consults a specialist, a physician skilled in the science of the mind, who gradually leads him into telling the story of his life. Searching the past for forgotten incidents is by no means an easy thing to do, because unpleasant thoughts, you remember, are repressed automatically and can only be brought up by association with other ideas.

The first significant memory that comes up is that of an incident which occurred when he was about ten years old. One night he attended a village entertainment with a grown-up friend. The hall was crowded and the little fellow was placed upon a window sill just above the stairway. He was terribly afraid of falling, but he held on, conquering his fear for perhaps half an

hour, when he was compelled to confess and was lifted down.

Now there appears another memory brought up by association with the first. At nine years of age his father had taken him to the top of a high tower upon which was a circular projecting balcony and, although it was protected by a railing, the child had been in mortal terror. His father, whom he feared anyhow, had laughed at him and compelled him to walk around the platform.

He remembers a still earlier experience. When he was about seven years old, one day at school, a fool teacher had held him by the feet, suspended head downward from the top of a high wall, threatening to drop him. This playful joke had made a deep impression. You will notice that his memories are coming up one by one, each in succession from a deeper level. Now comes the last, the deepest of all. When a child of three, one day at home he had been crying a great deal, much to the annoyance of a male visitor, who picked him up and carried him to a rain barrel outside of the house, threatening to drop him into the water if he did not shut up.

He has disclosed three elements in his mind injury: First, the fear of falling; second, that of being dropped; and third, in all four of his terrifying experiences the offender had been a man. Up to the time of his consulting the physican he had never realized the causes of his trouble, had never even recalled the incidents of his childhood. Now he knows that his fear is the logical result of mind injuries, and he is relieved of the fear of his fear, which riddance will help to restore his mental balance. It is the fear of a fear

that does the most damage. It causes us to become introspective, to examine and misinterpret our every action, to magnify and misconstrue the slightest deviation from the usual and ordinary.

What can be done about our phobias? Well, most of us can laugh at them—and then go on unconsciously making our daily lives conform with them, walking around and not under ladders; doing important things on the twelfth or the fourteenth of the month instead of on the thirteenth; jumping into a feather bed when it thunders; keeping away from cats; refusing to look down from a height; going to a doctor occasionally to be assured that we have neither cancer nor consumption nor corns nor chilblains, nor any other mortal disease! We can laugh at them, and we should laugh at them, not take them too seriously. It will help us, although we may not need help, if we recall the past and find the cause in some childish experience, just as we look at a scar on the surface of the body and say: "Oh, yes, I was scalded badly when I was a child."

Ordinarily, we should not bother any more about a mental scar than about a physical scar; but if you suddenly discovered a scar on your body that you could not account for, it would worry you somewhat, wouldn't it? Then, when you had finally remembered the cause, you would stop worrying. You will not be troubled if you can keep your sense of proportion, your "table of values." You can do this by avoiding as far as possible other worries and occupations which cause long-continued mental strain. They tend to bring on a morbid state of mind, especially if you have been losing sleep, and make you get things all out of proportion, magnifying the insignificant, just as a small

object held near the light casts a big shadow on the wall. Get back your perspective, and see where this little trouble belongs in relation to the big things of life.

Keep your body clean and your mind clean. Get plenty of play. It is a national failing that so few of us know how to play. We are so pushed from behind or pulled from the front by the necessity of high living, or by ambition to get ahead, that we rush gasping and panting through life, often to a fall.

If your mild phobia is becoming an obsession, take warning. You are not going crazy. It means merely that you have temporarily lost your mental poise. Brace up! Take a little time off for relaxation and amusement. Take your trouble out and look at it in the sunlight.

If you cannot do this alone go to a specialist and tell him all about yourself. He will help you to "get back." He will ask you a lot of questions, giving you a chance to let the light into dark corners. He will get you to tell him about your dreams, your foolish, disconnected, absurd sleep fantasies that are an index to your mental processes. Remember that dreams are mind realities and are not caused alone by pie, pork or plum pudding. He will fit together your dreams and your waking thoughts to make a complete picture which you yourself can look at and comprehend. And seeing the whole design and composition will help you to get back the proper sense of values.

But how can phobias be prevented? If it were possible, the best time to begin would be with one's ancestors, but the next best time is with parents, which is entirely feasible for the newest generation and for

generations to come. If you will remember that nearly all phobias are due to early impressions, mind injuries, harrowing experiences, the solution is clear enough. So many of these are the result of carelessness, indifference and neglect upon the part of parents. So many children are raised vicariously, the most important time of their lives supervised, if at all, by ignorant servants; or the white, unwritten tablets of their minds are scrawled upon with distorted caricatures of life, of morals, of sex, of every serious relation between the child and external things.

They hear ghost stories, tales of goblins, of bogy men lurking in the dark; fairy tales, the themes of which are murder and violent death. Is it any wonder that when they grow up they are afraid to come up out of the cellar, afraid to look back into the dark? Even very young children receive lasting impressions at a time when we consider them too young to know and understand what is going on about them. Disturbances at home, quarrels, deliberate maltreatment, bickerings of nervous, irritable parents—all these are more potent in creating mental injuries and have far more to do with morbid states of mind in after life than heredity.

Is it any wonder that children raised in such environment conceal within themselves, because they think them lewd, all questions of sex? If a child of six or seven years has not yet asked any questions about sex, scientists tell us that it is because he has been held back by a lack of confidence or by some repression from within. How much should be told the child is not necessarily the consideration. Certainly not more than is asked, provided there is a free, mutual confi-

dence between parent and child. But one thing is absolutely certain: the child should never be told a lie or an equivocation. You cannot fool a child, but you can destroy his confidence. And confidence, once shattered, can never be put together again by all the King's horses and all the King's men.

SIXTEEN

THE BIRTHRIGHT

SHORTLY after the beginning of the War of the Revolution a certain young man joined one of the many military organizations then being formed to defend the country. Like hundreds of other young men of his time, he was of good pioneer stock and had inherited at least the average sound mind and sound body. At the tavern in the town where troops were being mobilized he met a feeble-minded girl by whom he became the father of a feeble-minded son, thus becoming the progenitor of a long line of ignoble posterity.

After the war was over and he had returned to civil life this young soldier married a girl of good family and sound mind by whom also he became the ancestor of numerous descendants.

The history of these two families has been traced with painstaking and meticulous care and recorded under the name of The Kallikak Family, a family name invented by the investigator to conceal the real one.

Several years ago, while conducting a clinic for psychological research, Doctor H. H. Goddard and his assistants became interested in the family history of a feeble-minded girl, called Deborah, and after long and laborious research, they finally came upon the young Revolutionary soldier, Martin Kallikak, her great-great-great grandfather. One fact which made

these investigations successful was that the illegitimate son of Martin Kallikak had been given his father's name and surname. In consequence there are two lines of descendants of the same name which converge to the first Martin Kallikak.

The illegitimate son passed on to posterity his father's name and also his mother's mental weakness. Of four hundred and eighty direct descendants definite information was obtained concerning one hundred and eighty-seven, and of these one hundred and forty-three have been feeble-minded.

Four hundred and ninety-six persons are known to have sprung from Martin Kallikak's union with the girl of sound mind every one of whom has been mentally normal. Among them were doctors, lawyers, judges, educators, business men and farmers, some of them prominent in their communities and all of them respected citizens.

Here we have striking proof that mental as well as physical characteristics are transmissible. And also we have a striking instance of fraud committed upon a number of innocent persons. Long before they were born, these victims had been cheated out of their birthright.

Every child has a right to receive at birth the heritage of a sound body and a sound mind. But that one branch of Martin Kallikak's family had been disinherited while the others received each his proper share.

Not all feeble-minded children are born feeble-minded, there are numerous cases of arrested mental development after birth. This is especially true of those who, although below normal, are not so far below as to be mentally defective.

At one time, not so long ago but that most of us can

remember it, we assumed one of two attitudes towards backward children. We said, "Oh, well, what if he is a little slow, he will outgrow it later." Or we were hopeless about it: "What's the use? She's just stupid. Nothing can make her learn!" And she was neglected for the brighter children. Neither of these attitudes is right in the majority of cases and neither is entirely wrong.

Conditions after birth may retard an orderly and progressive mental development, as may be seen by the following instance: To the psychological clinic of the University of Pennsylvania was brought a boy of eleven with a history of five wasted years in school. His case seemed so hopeless that almost any one would have considered him feeble-minded. But a physical examination disclosed a number of physical defects. He had adenoids, diseased tonsils, imperfect vision and decayed teeth, and besides, he was poorly nourished.

Then began a general physical house renovating. The adenoids and tonsils were removed, his vision corrected by glasses, his teeth cleaned and filled. He was sent to a school for backward children during the summer but returned to his former class in the fall and within six months he had advanced two grades. Restoring his birthright by ridding him of his physical defects had transformed a stupid boy into one of more than average intelligence and guaranteed to the community a useful citizen.

If left to himself, the stupid child will become a stupid adult and stupid citizens are a liability to the state. Many of them are troublesome members of society and from their ranks come most of the criminals. On the other hand, if properly cared for, a very large proportion of prospective dull citizens may be

salvaged. For these reasons it is important to see how we assay mentally and if anything is wrong, what, if anything, can be done about it.

Before the war we were rather smugly complacent about ourselves. We thought that, on the whole, we ranked rather high physically as compared with the people of other nations. The physical examinations of our boys taught us a lot about that and we shall remember it for a long time.

We thought that we were rather superior intellectually, that Uncle Sam, meaning our average selves, was pretty shrewd, at least a little shrewder and brighter than the average selves of any country. We have no figures to show how we compare with other nations in this regard, but certainly the psychological examinations of our soldiers did little to elevate our self-esteem.

Of the nearly two million men, both officers and recruits, who were examined psychologically, more than fifty per cent had the minds of children of thirteen years or under. Of these, forty-five per cent had a mental age of twelve or less; one-third of this forty-five per cent were mentally as children of ten years and ten per cent of the nearly two million soldiers were of still lower levels, or mentally defective.

It is a reasonable inference that our young soldiers were not, as a whole, mentally inferior to those who stayed at home. Consequently we must believe that more than fifty million people in this country are below normal in intelligence, including several million persons of all ages and of both sexes, who are mentally defective.

That was rather a shocking disclosure which the war brought about. In a sense the psychologists of the

army merely reduced to tables of figures what we already knew, that some people are bright and some are not. But the real disclosure, however, lay in the fact that so few are really bright, and also that there are, among adults as among children, so many different grades or levels of intelligence. As a nation is a composite of the individuals in it and is not merely a country with certain geographical boundaries and physical resources, it can be no stronger and better than the composite physical and mental strength of its people. Consequently the only way to secure the future life and health of the nation is to get at the individual in order to raise the average of intelligence as well as the average of bodily fitness.

All that a human being is and all that he will ever become in this life depend upon two factors, heredity and environment. And all that a nation is or will ever become is determined by the minds and bodies with which its people were endowed at birth and the manner in which their heritage is cultivated.

For the simple reason that one cannot choose his parents and grandparents, no one can determine the quality of his mental or physical endowment. At some time, let us hope in the not too far distant future, society will do that for the generation to come. It will declare that those with transmissible diseases or with defective minds shall not bring forth their kind. At present this protective attitude toward posterity is rather nebulous, although a few states have already passed or are considering laws with this end in view.

The foundations of a healthy body are laid before birth and during childhood. If these are secure and strong, by the time the child reaches full growth he has a good chance of living out his expectancy, barring

accident and an overwhelming disease. The same thing is exactly true of the mind. Given a good average brain at the start and normal, healthful surroundings for both mind and body, and there need be little apprehension for the child's mental development.

This fact makes the period of infancy and childhood so important to the welfare of the nation and gives an added value to the present brilliant achievements of modern psychology in the study of the child mind.

Twenty-five years, or one generation, ago, as compared with the knowledge of the present day little was known about the psychology of children and its bearing upon their future mental development. At that not very remote period a child had but one age, that which was reckoned from birth. Now we speak glibly of the mental age, which may be totally different from the other. In fact we know that every child has four ages, which may be all alike or may vary materially, each from the others.

Now, if an intelligent mother is asked concerning her offspring the simple question, "How old is Willie?" she may overwhelm and confuse the casual inquirer by saying: "Willie was ten last Tuesday. He is also twelve and ten and twelve." Every parent knows the chonological age of his child but it is a wise parent who is acquainted with the other ages.

Because of their bearing not only upon the mental development of individuals and upon the future intellectual and moral standards of the whole nation, it is important to know something about these other ages. One knows, of both children and adults, that some are brighter than others. But it is not so generally understood that a marked intellectual discrepancy in early childhood will remain throughout life. Very backward

children will still be relatively very backward when they grow up. They will never catch up with those who show markedly greater intelligence.

The doctrine of mental levels was a direct result of exhaustive examinations of children, supplemented by investigations into the minds of our soldiers. The science of the mind has recently caught up with the science of the body. Just as new appliances and apparatus are coming into use to test the functions of the various physical organs, so new methods are being devised and perfected to sound the depths of intelligence, to measure the intellectual faculties and to predict with reasonable accuracy the extent to which they can be developed.

Francis Galton was the pioneer in these studies. In 1883, after having devoted many years to his investigations he wrote concerning those first crude mental tests:

"It is to obtain a general knowledge of the capacities of a man by sinking shafts, as it were, at a few critical points. In order to ascertain the best points for the purpose the set of measures should be compared with an independent estimate of the man's powers. We may thus learn which of the measurements are the most instructive."

After Galton there were many independent investigators both in Europe and in this country. But it remained for Binet in France and his assistant, Simon, to devise a set of mental tests and to correlate them with the various ages of children. These tests have been considerably modified in this country until at the present time they are fairly accurate gauges of intelligence.

A child's mental age is the age at which the average

normal child can do certain things which he could not do at an earlier age. For instance, if a child passes all the tests that a normal child of ten can pass, his mental age is ten years, no matter what his chronological age may be. If he can pass the eleven-year test his mental age is eleven, and if he fails to pass the nine-year-old tests it is below nine. It can be readily seen, then, that a child may be ten years old dating from birth and yet have a mental age of seven or eight or twelve.

Although the Binet-Simon tests have been somewhat modified by psychologists in this country, for purposes of illustration a few of them are given here to show that they are based upon the ability to learn, upon mental alertness, rather than upon the exact amount of knowledge acquired at any given age. The following examples will serve this purpose:

Mental Age Four Years.

1. Gives sex of self.
2. Names familiar objects (as key, hat, watch).
3. Repeats correctly three digits (as 3-9-1).
4. Tells which of two lines is the longer.

Mental Age Five Years.

1. Tells which of two weights is the heavier.
2. Copies a square so that it can be recognized as a square.
3. Repeats ten syllables (as "John went out. He went to the store for bread.").
4. Counts four objects placed in a row.
5. Re-forms a card from two pieces formed by cutting a card diagonally.

Mental Age Ten Years.

1. Names nine different pieces of money.
2. Draws two simple geometrical figures.
3. Repeats six digits.

4. Answers intelligently some simple problem questions (as "What ought one to do before undertaking something important?").

5. Uses three words, as New York, hat and street, in one sentence.

Mental Age Twelve Years.

1. Repeats correctly seven digits once in three trials.
2. Defines charity, justice, goodness.
3. Repeats a sentence of twenty-six syllables.
4. Resists suggestion.
5. Solves problems of fact (as, "My neighbor has been having strange visitors. He has been receiving one after the other a physician, a lawyer, and a clergyman. What has happened at the house of my neighbor?").

Intelligence increases from birth to about the age of fifteen. A certain proportion of persons reach higher levels but the majority do not get beyond the mental age of fourteen. This statement may be considered as disparaging to the average intelligence, but the fact is that the boy or girl of fourteen has intelligence enough to carry him through all the emergencies and vicissitudes of life. What he lacks he can acquire later, knowledge and experience.

One of the most interesting facts brought out by these investigations of the minds of children is that at any given age the final mental level can with reasonable certainty be predicted. For example, if a child is ten years old chronologically and has a mental age of ten, his mental age at fourteen will be normal, or fourteen. If at five or seven or ten years old, he is brighter than the average child of his age, he will be about that much brighter, or more than fourteen years old mentally, when he reaches his fourteenth year.

Also if, for example, at ten years of age he has the

intelligence of a boy of seven, he will never wholly make up the discrepancy. No amount of education can bring him up to the normal level, because intelligence is the ability to learn and, lacking it, the intake and assimilation of knowledge will be limited.

The reader may argue:

"Well, if intelligence is a matter of heredity, if every one is born with just so much capacity for development and no more; if no amount of training can get him beyond the final level to which he was foreordained, what of it? What is the use of worrying about it if nothing can be done?"

But it isn't true. And especially it isn't true concerning the great intermediate class, those who are not too far below the normal at birth. Something can be done about it if it is done in time. As this has to do with the brain and its development it will be taken up later. Just now we are concerned with the other two ages of a child.

Let us suppose, then, that a child is ten years old and that his mental age is also ten. Of course he is going to school. What grade is he in? The fourth? Then another of his ages is normal. His pedagogical, or school age, corresponds with the other two ages. He is in the proper grade for a child of ten.

But he might be in a lower grade and still be as bright as any one in the ten year class. He might have started late in childhood, and have been moved on step by step, without reference to his brightness but merely in conformity with the regular order of progression. Our schools have not yet adopted the policy of treating scholars as individuals. Most schools are like machines. The raw material goes in at one end and in due course of time there comes out at the other end

a more or less finished product. If a child goes into the machine at eight instead of six years his school or pedagogical age will probably remain below normal to the end.

The trouble with our school methods is that they are not flexible. This is especially the case where a child is backward in one or two studies, although normal in the others. His particular needs are not usually taken into consideration. He goes through the mill steadily like the little raw material that he is.

Binet, visiting a boy's school one day, asked the teacher which was his brightest scholar.

"The boy over there," he said, pointing to a youth.

"Indeed," said Binet. "How old is he?"

"He is twelve years old."

"I suppose, then," said the great psychologist, "that the other boys are of about the same age?"

"No," answered the teacher, "the fact is that the rest average about ten years."

"Then he is not the brightest boy in the room, but the dullest." Whereat, of course, embarrassment on the part of the teacher and a new light.

Now the idea which Binet had in mind was absolutely right, but there is another side to be considered. Suppose this boy had entered school two years later than the rest and had been caught in the machine. Or, suppose that he was under-developed physically. This latter supposition brings us to the fourth age of the child.

In every school about one-fourth to one-third of the scholars are mentally backward. Some of these just manage to get through and progress from grade to grade with the others; and some are repeaters, that is, they remain in each grade an extra term. Their

teachers may take greater pains with them but it is of no avail; they are just stupid. At least that was always the verdict, without any attempt at discrimination between them, until something was learned about this fourth age.

Now, however, the up-to-date teacher does not so classify them all indiscriminately until the school physician passes upon them. If this physician is also up-to-date he will examine each backward child as to his eyes, ears, mouth, nose and throat, lungs and heart to determine whether there are any physical handicaps.

And, if he is so modern as to know about the fourth age he will look at the teeth, not only for defects, but exactly for the same reason that a prospective purchaser looks into the mouth of a horse. A child's age, not in years but his fourth, or physiological age, can be estimated by the teeth. In more than fifty per cent of children the permanent teeth appear at periods and any variations indicate variations in the age of the body. If a child has more permanent teeth than normal for his age his body is older than his age in years. And if he has fewer permanent teeth than he should have he is physiologically younger.

Another reliable indication of the age of a child's body is to be found in the bones, especially of the wrist. The wrist contains eight small bones, the development of which from cartilage is normally completed at a definite time. An X-ray picture will disclose the physiological age of a child by the shadows which these bones show. The more completely they are ossified the denser and more definite their shadows on the plate.

This fourth age is an important factor in determining mental ability and especially in predicting its final

mental level. It would be obviously absurd to say of a child whose mental age is below his age in years, that he is dull, if his body is that of a younger child.

Another instance of the difference in physiological age is the period of pubescence. This change usually appears at about fourteen years, but with some it is delayed two or three years longer, and with others it is advanced.

Girls mature about two years earlier than boys. This difference in physiological age between the sexes is evident very early in life, being well marked by the end of the first year. At four a girl is physiologically one year older than a boy of the same age. At seven and a half she is as old, structurally, as a boy of nine, and at twelve and a half she equals a boy of fifteen. A knowledge of this fact may console those males who have so often been told that girls are brighter than boys.

They are, chronological age for age, but psychologists assure us that it is because their bodies, and consequently their brains, are older. Later on the boys will catch up and reach, let us say, the final mental level of their sisters.

The law of mental levels asserts that every human being is born with certain possibilities of intelligence, potentialities for reaching a final stage of mental development which under favorable circumstances he will attain. We are not all equipped alike at birth; some, like the men in the parable, receive five talents and others less. Some will develop their intellectual inheritance and some will bury it and be content. And by no means all of us have equal opportunities for investment and increase. Development of brains depends

not only upon the amount of the original capital but upon that other great factor, environment.

Intelligence is a matter of neurons, which is the name for the nerve cells and their fibres. Each person is endowed at birth with a certain number but their development is a matter of conditions after birth. Every process of the mind is due to a physical functioning of the brain. There is a direct relationship between the growth of intelligence and the increase in size of the nerve cells as well as the increase in the number and size of the fibres which connect them with each other.

Like every other organ and tissue of the body the brain's growth depends upon the amount and kind of nourishment it receives. It can be starved or well nourished, according to conditions elsewhere in the body. Like other organs it grows in size and weight. But there is this exception, that the brain at birth weighs about one-fourth of its final weight and other organs are about one-tenth to one-fourteenth as heavy as they will be at maturity.

There is another peculiarity about the brain which is of greater significance. During the first year its weight increases two and one-half times and by the middle of the fifth year it has attained over ninety per cent of its growth. After that the rate of increase rapidly diminishes and by the age of fifteen it ceases.

Unless caused by a disease of, or an injury to, the brain, there is no danger that a child will become feeble-minded after the age of six. The tremendous significance of this lies in the fact that if the brain is well nourished during those early years it will have completed most of its growth and the ultimate intelligence will be fixed.

It can readily be seen, then, that this is the most critical period of life. If a child has inherited the proper number of normal neurons and passes the first six years of life under proper conditions, well nourished and not handicapped by bodily defects or infirmities, nothing, except disease or accident, can prevent its reaching the final mental level for which it was equipped at birth.

Let us suppose that a child has been born of healthy, normal parents, both of whom have at least the average intelligence. Every child is entitled to this but by no means all get it. Some are born of those either physically or mentally deficient, or both. The next right of the child is to be breastfed. There is no substitute for mother's milk. It was intended to pass direct from mother to offspring, and was never meant to see the light of day. Some mothers unfortunately are unable to nourish their infants, but on the other hand many of them voluntarily relinquish this high function of motherhood. The only valid excuse for doing so would be a lack of supply or its inferior quality.

After weaning, the child should receive a well-balanced diet. Fully half of all children are undernourished in one way or another. This applies to those of well-to-do parents as well as to the others, because, unless carefully watched, they eat too much starch and sugar and not enough of the whole-grain cereals, which contain not only bone-forming minerals but also the essential vitamines. These are found in small proportion in almost all foods except the starches, but they are more abundant in fresh fruits and vegetables and in the outer layers of grains.

After a child reaches the school age his diet is

largely left to chance and his own selection. Usually he sleeps late in the morning, bolts his breakfast, rushes off to school and halfway through the morning he is hungry. At every opportunity he satisfies his hunger with candy, spoiling his appetite for lunch. Then, midway through the afternoon, there is the same hunger and the same method of allaying it.

Of the backward school children, whose school ages are less than their chronological ages, some lack native intelligence, but with many the cause is undernourishment. This has been proven time and again by investigators in many cities. In Philadelphia, for instance, in a school in the poorer district, the experiment was tried of giving the scholars an extra meal, all they could eat once a day during school hours. Within a year most of the dullards had caught up with the others. Esau sold his birthright for a mess of pottage. Many a child's intellectual birthright could be secured to him by one good mess of pottage a day.

A good deal might be said concerning physical defects, but this deserves especial consideration. In many schools the children are now examined by regularly appointed physicians. But some day it will be more generally understood that the time to examine children for defects of any kind, mental or physical, is before the school age, during that period of wonderfully rapid changes in the brain, between birth and the sixth year. It is at this stage of a child's development that its future can be made or marred.

Defective vision might be allowed to await correction until the school age, but adenoids should be removed as early as possible and all other causes of obstruction to the free passage of air into the lungs, including diseased tonsils.

But what can be done with those children who are physically normal but through whose thick skulls knowledge percolates slowly if at all? Here is a case in point, as narrated by a correspondent:

"We have in Iowa, as in most states, a compulsory educational law keeping youngsters in school until they are fourteen years of age, a certain length of time each year. We had three brothers attending school, youngsters from ten to fifteen years, all in very low grades and seemingly unable to learn.

"An epidemic of scarlet fever left one of our teachers without scholars for about two weeks and we put those three youngsters with her to see if by any possibility, by any intensive training, she could do anything with them. Their minds seemed like a rubber ball; as long as you put a little pressure on you could see some slight effect, but the moment the pressure was withdrawn back went the mind to the old status without retaining anything.

"After that teacher had given her best to those youngsters for a couple of weeks with no results we decided that the best interests of the school did not require the waste of time on such pupils."

Here was a distinct and laudable attempt to solve a problem with regard to the individual. But the narrative points indirectly to two weaknesses. First, the experiment did not last long enough. At least a whole school-year would be required to get results, and probably longer. Wherever communities can afford it, and no community is too poor to ignore this problem of the backward child, special classes should be established for just such cases, with teachers who are chosen because of their high order of intelligence

and their knowledge of the psychology of children.

In the second place, those who are hopelessly unable to learn from books should not be given up, left to shift for themselves, allowed to grow into men and women without equipment of any kind for earning a living. Many of them can be taught to work with their hands so that they will have useful occupations later on.

Money spent in saving a life to usefulness is the best investment in the world. And the poorest economy is saving money and thereby creating a human derelict. Human derelicts are expensive. A large majority of delinquent adults, variously estimated at from fifty to eighty per cent, are of inferior mentality. They are unfitted both in mind and training for any useful occupation and they resort to their poor wits to procure a living by dishonest means. The average criminal is shrewd rather than intelligent. In his astigmatic brain, where images of realities are distorted, he has one fixed idea. The world owes him a living.

With one slight modification it does. It owes him a chance to earn a living, by having his birthright, however small or great, developed to the limit of its possibilities. But payment of the debt should have begun in infancy and childhood, not allowed to stand until too late and it has become outlawed.

Most of the social unrest in the world arises in the ranks of the mentally and emotionally inferior. The misfits are the malcontents. They need only shrewd leaders of a somewhat higher grade to crystallize their discontent into some sort of ism, which promises a panacea for all economic and social ills. Blind followers of the half-blind.

Here is a recipe for making a malcontent. The

directions, like those one frequently finds in a cook book, "a pinch of salt," "a lump of butter the size of an egg," and "sweeten to taste," are somewhat elastic. So these ingredients may be large or small in quantity, according to taste or chance; and any one or several may be left out altogether.

Take at least one feeble-minded ancestor, or several whose mental grades were below normal. No, this is not necessary. Once in a while a genius arises in such a family, and also, occasionally, a feeble-minded person is the fruit of a sound tree. Suppose we start at birth.

Take a child who is poorly nourished, especially during that magic period when the brain grows and the neurons develop with such marvelous rapidity. It would be better to have the mother sickly so that the child would be illy nourished before birth. Neglect him up to the sixth year; let him breathe bad air, give him little sunlight, have his surroundings as dark and damp as possible.

As he grows up beyond infancy, give him improper food, coffee as early as possible, and sodden bread; fried meat like leather, pastries and candy bought with every spare dime. The moral atmosphere also should not be forgotten. Let him hear his elders quarreling. Let him witness repeated instances of brutality in the family. Punish him often, unjustly, and fail to mete out the promised punishment that he deserves.

Leave the matter of schooling entirely to himself and his teacher. If he does not attend school regularly the teacher and the truant officer are paid to attend to that. By this time he is duller than others of his age. But many school laws say that a child must attend school until fourteen, so let him remain, a frequent

repeater, learning nothing from books and nothing useful to do with his hands.

At fourteen he will not have reached nearly to the highest common school grade but he will be educated as much as the law requires. He will either loaf or hunt a job, the former if his family, perhaps a working sister, supports him; the latter if necessity presses. Because he is poorly equipped, even with such useful knowledge as his brain could have acquired, he will go from job to job, dissatisfied with each in turn, or he will be discharged from each as an incompetent.

Now he is ripe for revolt. Let some one hold up to him the picture of a change in the existing order of things, a change that will secure to him an equal share with those more prosperous. It will make little difference to him how the change is to be brought about, whether peacefully or by violence, he is for it.

If his early life has been spent with criminal companions he may choose to fight society single handed and take for himself on occasion that which he thinks has been unjustly acquired by others. Or, if not criminally inclined, he may find solace in an "ism" and shout for equality.

If one wants to make a cake or a pie one-half or one-third as large as the recipe calls for, the quantity of the ingredients is reduced by that much. Analogously, if one wishes to make merely a misfit in the world the ingredients that go to the making of an enemy of society should be reduced in quantity, perhaps some of them left out altogether. By properly mixing and judiciously measuring them it might be possible to make almost any kind of square peg for the round holes of life.

And also, by using other ingredients, the opposite of those mentioned, the result in all probability will be a useful citizen, fully come into his inheritance, at least half of which has been put in trust for him at his birth.

SEVENTEEN

WHAT IS WRONG WITH OUR YOUNG MEN?

NATIONS, like individuals, are subject to delusions, because the national mind is a composite of individual minds. The war dispelled several of our national delusions—some of them with difficulty, others more or less easily. The one about fighters being born and not made and an army springing up overnight, like Minerva fully armed from the head of Jove, vanished before we got into the war. As a delusion it was a failure, because it fooled comparatively few of us.

There was another one, however, that caught more of us and for a long time refused to be downed. This was the belief that we were the strongest, most vigorous, healthiest people on the footstool.

"Look at our boys!" we said. "Aren't they bigger and brawnier than any other in the world? Isn't their average height greater, and the chest development? Why, we have more and better food, more and better public schools, more outdoors, more personal freedom. We are on the way to develop a new race—the American—with food and exercise and fresh air as foundations."

When the war came, with its enlistments and its draft, gradually it began to drift in on us that we were going to have trouble in getting an army.

The draft boards saw it first, and later the camp examiners. These boys of ours had all sorts of things

wrong with them. They had bad teeth, bad eyes, bad hearts and bad feet. Before long our physical standards had to be lowered somewhat in order to get an army of sufficient size. Other nations had had to resort to this expedient, but we thought we were different. And we formed another army, of substandard men, an army of noncombatants, who were just a little below the physical standards.

Now the army finally assembled was the finest in the world, physically and mentally. But to get the first two and a half million men about three and a quarter million were examined. And of this two and a half million several hundred thousand more were placed in the limited-service ranks because of partial disabilities.

Sixteen per cent of our boys were found totally disqualified and perhaps another sixteen per cent were not quite fit to fight because of defects which lessened their efficiency. Some of these defects were comparatively trivial, but they were serious enough to debar men from active military service.

All this is a matter of record, but what of it? What are we going to do about it? Well, the Army did a lot about it. Many of the substandard men got rid of their partial disabilities in the Army.

Outdoor life accomplished a part of this change, but intelligent treatment, physical exercise and in many instances comparatively slight surgical operations did more. For instance, mild degrees of flat foot were cured by the wearing of army shoes instead of the narrow-toed, mal-shaped, stylish variety worn by most civilians. And many thousands of men were operated upon for hernia, or rupture—a simple operation, not at all dangerous to life in skilful hands, but which

added to their life expectancy and their efficiency, either civil or military.

Even in the graver conditions which caused their rejection many were benefited. Most of them had never been examined before. They learned their weaknesses for the first time, and knowing them they were able when they returned home to safeguard themselves against disaster.

The war gave us the first opportunity to find out what is wrong with our boys, and of course by inference what is wrong with the rest of us. It cannot be supposed for an instant that the boys have a monoply of these disabilities. Be sure that other people have them also, and in about the same proportion; that where our boys were found wanting the rest of the nation will average no better.

Before the war we knew what people died of; we had plenty of mortality statistics. But we had no statistics of the conditions which do not necessarily cause death—the ills and disabilities that lessen efficiency, that cause discomfort, that subtract from the sum of human happiness. Since the war we can arrive at an approximate idea of these and in what proportion they occur among us all.

The seven conditions to be discussed here, ranging all the way from the apparently trival to the very serious, from bad teeth to bad heart, were selected for two reasons: First, they together were responsible for more than half of all the disabilities in the army examinations and may be considered as quite common to all of us; second, they can be either prevented, corrected or ameliorated, if we have the proper knowledge.

It would be a discouraging occupation, this survey of our physical disabilities, if it were not for the fact that

in most instances they result from carelessness or ignorance rather than necessity.

This is obvious, for instance, in the case of defective teeth. There may be some excuse for the vacancies in one's mouth, but certainly there is none for the neglect of one's teeth. Tens of thousands of men were disqualified for this cause. Many of them had more decayed than good teeth. Many mouths were filled with snags and blackened disintegrating stumps and diseased gums.

Bad teeth are not only a source of great discomfort but are an actual menace to health. They cause innumerable troubles, both near and remote. Bad teeth prevent proper mastication of food, which is the first requisite of good digestion. The teeth are placed in the vestibule of the digestive apparatus and were not intended entirely for their cosmetic effect. Many people use them like the girl in the tooth-powder advertisements—only for ornamental purposes. A great number of us bolt our food whole, washing it down with water or coffee or milk, forgetting that if we do not use them our teeth will not always be an ornament. Disuse brings indigestion and dental decay.

One hears of focal infection quite often now, even in general conversation. Figuratively speaking, pyorrhea seems to be in everyone's mouth. Bad teeth are a common cause of focal infection, because the pus which forms about their roots is absorbed and causes much general disturbance, not the least of which is arthritis, or inflammation of the joints. It is not at all unusual nowadays for one to go to his dentist to be treated for rheumatism. Even apparently good teeth may be infected at their roots, causing many forms of severe but obscure illness.

In these days, when dentistry has become a fine art, and in the United States, where it has reached nearer perfection than in any other country, specific directions for the care of the teeth may not be considered necessary. In general it may be said that they should be used, should be kept clean, cavities should be filled, defects removed—and finally that they should be discarded when they have become useless and a menace to health.

The reasons for including flat floot in our category may not at first be apparent, especially to one who is so afflicted. He considers himself a victim of circumstances over which he had no control. If you are not a sufferer from this cause take this bit of advice: Do not speak of it jestingly to a flat-footed acquaintance unless you happen to be bigger than he. Joke as much as you like about anything else, however grave, but spare him, and yourself, on this one subject. His flat feet are apt to make him hypersensitive at both ends—antipodally, as it were. Here is some more advice: If you speak of it as a minor ailment please hasten to explain that by "minor" you mean "not fatal." That is about the only good thing to be said about it. It causes an infinite amount of suffering, but no deaths.

If all the flat-footed persons in this country could be mobilized they would make an army of several millions—but not as a standing army. It is about the commonest minor ailment that affects mankind, and it is a respecter neither of age, sex, color nor condition of servitude.

Perhaps the army figures will give some idea as to its prevalence. Of the first million men examined 177,450 were flat-footed. Not all in the same degree, however; and by no means that many were rejected.

Some were benefited in the camps by certain prescribed exercises and by wearing army shoes, and were made over into soldiers. But most of those who were not rejected were put into noncombatant organizations and given occupations more or less sedentary.

Now, if more than one hundred and seventy-five thousand young men out of a million had flat foot one has only to multiply the first number by one hundred to arrive at an estimate as to the whole country. This stupendous result—more than seventeen millions—may not be accurate, but as we have no other figures, each of us may adopt for himself any which appeal to his reason or to his imagination, and still have enough fallen arches to go around.

The term "flat foot" includes any degree of mildness or severity, from a slight stretching of the ligaments, which bind the bones of the foot into an arch, to the arch which makes a hole in the ground. Even the mildest is painful, however, and all more or less incapacitate the victims.

Shoes are one cause of flat foot. Primitive man walks upon his naked or sandaled feet; he does not cramp or bind them, and the foot muscles—having perfect freedom of movement—are all of them used in walking. Primitive man walks. He does not stand much, to stretch and strain his foot muscles without giving them proper exercise. And above all, primitive man is not a slave to the modern shoe with narrow toe that is made to fit no foot in its natural shape. Also, the savage walks with his feet parallel, which places the weight of the body on the outer half of the foot, and not with the toes turned outward, which is an unnatural posture. And in walking he lifts his weight

upon the ball of his foot, thus exercising and strengthening all the muscles.

To avoid flat foot children should be properly shod. They should be taught to walk and stand properly. Of course these rules also apply to adults. If you have weak arches learn to walk with the feet parallel or pointed slightly inward.

You may remember that you were taught in childhood to turn your toes out. This is considered to be the correct method in walking or standing and to lend an air of gentility to one's appearance, but it does not conduce to one's endurance in walking. Also the glide may seem an elegant method of locomotion, but the proper thing is to rise each time on the ball of the foot so as to exercise the muscles and ligaments. This also implies that the toes must have plenty of room for free movements.

A few simple exercises will help to strengthen the arch. If you are suffering from flat foot in any but the extreme degree take this home and try it, not upon your piano but upon your bedroom floor, after you have shed the cares and the habiliments of the day:

Standing with the feet parallel or slightly toed in and firmly planted, rotate the thighs outward from the hip without bending the knees. This exercise will correct the tendency to throw the weight upon the inner surface of the foot, thus exercising the proper muscles.

Lift the toes forcibly as far as possible from the floor. Also, separate the toes by muscular effort, one from another, either in the same or in a separate exercise.

Standing upon a board or anything above the surface of the floor with the ball of the foot upon the

edge, forcibly bend the toes downward and back a number of times.

Each exercise may be repeated as often as time permits or inclination dictates.

To jump abruptly from one extremity to the other—from the feet to the head—anyone not a student of psychology might think that mental defects do not belong in our list because they are neither avoidable nor curable and because they could not have occurred with great frequency among our young men.

But there are many kinds and degrees of mental defects. Every insane asylum has its idiots and its criminal insane, almost every community its village fool, every schoolroom its stupid child. Many families possess one member who does not measure up to the rest in intelligence. In other words, mental defectives grade all the way up from those who are mentally void to those who are merely slow, and they cannot be grouped together any more than physical defectives.

Not more than two centuries ago the insane were either totally neglected or they were venerated because they were considered "possessed." No attempt was made to classify them or to treat them intelligently. And until recently mental defectives of the higher grades, those just below normal intelligence, were not classified. Stupid men and women were just fools, that was all, and backward children were merely stupid or lazy.

Now we know that many children are backward because they cannot see clearly, needing glasses. Or they cannot hear well, or cannot breathe properly because of obstructions in the nose or throat. And these defects are being discovered by systematic examinations of school children, and removed when possible.

Last of all, we are beginning to show a little gleam of intelligence here and there throughout the country—it is by no means general—in our treatment of children who do not have imperfections of sight or hearing or respiration but are merely mentally slow. Tests are used by which they may be graded according to age, not of their bodies but of their minds. These tests are many and varied. They include, among others, tests of their ability to copy from memory both simple designs and sentences. Also questions are asked which require analysis and judgment in the answers as, for instance:

You are walking along a country road and see upon a blacksmith shop a sign: "Three miles to Jonesville. If you cannot read, ask the blacksmith." Or, answer this: "What would you do if you missed your train?" If anyone sprung these on you suddenly you would probably think him mentally deficient, but if you failed to see the absurdity in the first proposition or to answer properly the second you yourself would be so classified, and your mental age would be placed at about seven or eight. Many a prospective soldier failed in the mental tests.

Of five hundred thousand men rejected more than twenty-five thousand were mentally defective.

Mental development, like physical development, is partly a matter of proper nourishment in childhood. Many a backward child has been brought up to normal intelligence by being fed one good wholesome meal a day. In some of the schools of our large cities children have been given at noon all the milk they could drink, with bread and butter and a cereal. Within a few months the stupid children had caught up with the others. This is not a startling fact. It is quite ob-

vious, and the wonder is that it was not sooner recognized. The brain, to function, needs nourishment just as much as the rest of the body—and also fresh air. Stuffy schoolrooms make sluggish minds, and children in open-air schools thrive mentally as well as physically, because mental activity depends upon physical well-being.

One of the indefensible customs with regard to school children has been our grading them according to their ages without reference to their minds. One might as logically order a suit of clothes by mail, giving his age only. Children of the same age come in assorted sizes mentally as well as physically. Many a boy or girl quite fully grown possesses the mind of a child of seven or ten. The child's thought processes must be developed according to his individual needs.

Within a generation or two our intellectual average will be higher than it is to-day because we are beginning to see these things. Here and there the psychologist is at work in the schools analyzing the minds of the children, discovering their mental quickness or slowness, their visual and auditory memories and their natural aptitudes for certain lines of study.

In our gradual approach from milder to graver conditions the next subject on our list is hernia. Logically hernia, or rupture, might be classified as an unavoidable condition, but this would be only partly correct. Of rupture it may be said that some are born with it, which is a matter entirely beyond their control; some acquire it, by unnecessarily violent exertion; and some have it thrust upon them, by accident or by emergencies that require extreme muscular effort.

That it is not a rare condition may be inferred from

the fact that more than twenty-eight thousand men examined for the Army were ruptured.

Strictly speaking, a hernia is the protrusion of an internal organ or tissue through an abnormal or an abnormally enlarged opening. For instance, one may have a hernia of the brain through the skull if a part of the bone is gone and there is increased pressure from within. But ordinarily rupture means the protrusion of a part of the abdominal contents, and this is the sense in which the word is employed here.

Now the explanation of rupture is simple. The abdominal wall consists of: First, the skin; then fat, more or less; then strong muscular bands that hold the contents in place. Upon the firmness or relaxation of these muscular bands depends the shape of the abdomen. Flaccid muscles cause it to be more or less pendulous. The shape also of course depends upon the amount of fat in the wall, but this we need not consider in discussing the mechanics of rupture. Lining the inner side of the abdominal wall and also the intestines are two layers of a smooth, shiny, self-lubricating membrane, the peritoneum.

The two layers of this membrane glide one upon the other as the intestines move about in performing the act of digestion. The intestines, it may be said, are seldom entirely still. This absolute freedom of movement without friction gives to the abdomen one characteristic of a bladder full of water. That is, pressure exerted upon it anywhere causes an equal pressure from within at every point. Now if you press upon a filled hot-water bag, for instance, there will be equal pressure of the water upon every part of the inner surface of the bag and any weak place will give way.

There are certain naturally weak places in the ab-

dominal wall where the muscles cross, which are points of exit for cords or ligaments which belong partly within and partly outside of the abdomen. These weak spots are the usual sites of rupture. Violent pressure, as from great muscular exertion in lifting, may cause these natural rings, as they are called, to stretch and allow the exit of a small part of the abdominal contents. In protruding, the intestine pushes ahead of it the inner lining of the wall, which forms a sack like the finger of a glove.

The danger of a hernia lies in the fact that if not pushed back and held in place by a truss it tends to increase in size. But the greatest danger is that it may be caught and choked where it emerges through the ring. Strangulated hernia is the proper name for this unfortunate condition. And strangulated hernia is an instant menace to life, requiring immediate operation. Whether or not one who has a rupture is in any way responsible for its cause, there is but one safe thing to do about it, and that is to have it corrected by an operation. This is the only sure cure. Trusses are a poor substitute. They are intended to press upon and close the ring, but they are often inaccurately fitted and are easily misplaced. The operation for hernia is usually quite simple, and in skillful hands is entirely safe.

It is not so easy to classify venereal diseases, because one must consider not only those who willfully put themselves in jeopardy but also the innocent victims—the women and the children.

There are no statistics concerning the prevalence of venereal diseases in this country, because they are not usually reported as are other communicable diseases.

In the examinations for the Army, however, these

matters were brought to light. Of the first million men nearly twenty-nine thousand were victims of the various forms of active venereal disease. Comparatively few were examined for the chronic forms, but it has been estimated that if every man had had a thorough examination for the chronic as well as the active forms of venereal disease more than five hundred thousand would have been found to be afflicted.

It was one of the greatest problems with which the Army had to deal, because it was necessary to protect from infection the men who had been accepted. An outstanding fact was that comparatively few men contracted any venereal disease after they became soldiers.

The army solution is just as applicable to private life. It was twofold. First, publicity. The Army set out to tell the soldier all about the dangers of venereal disease. A moving picture very frank in its treatment of the subject was shown to all the men in the camps. It carried a heart-interest story which held attention, but the very frankness was gripping. There was nothing of mock modesty or innuendo in it, nothing to rouse grins, nudges or whispers. The men were intensely interested, and results showed that most of them took the lesson to heart.

And then there was prophylaxis, or prevention. Men who had exposed themselves to the possibility of infection were obliged under penalty for disobedience to report at once to their officers for treatment. This rule obviously was not based upon highly moral grounds, but its enforcement saved a great many young men.

Experience in the Army taught the need of frankness in such matters in the home and in public talks. Also it emphasized the need of public clinics in all com-

munities for purposes of treatment and prevention. Knowledge would not only keep many from transgressing but would do away with a great deal of suffering among the innocent; and especially it would prevent a certain virulent eye disease of the newly born, which causes by far the most cases of blindness.

Innocent babes acquire this disease of the eyes at birth from mothers who are themselves innocent and totally ignorant of their own condition. To avoid the destruction which almost inevitably follows it is now a practice among physicians to instill into the eyes of the child immediately after birth a mild solution of nitrate of silver. Many doctors have adopted this routine practice at all births, even though there may be no suspicion on their part that the contagion is present. But because this is not universally the custom many babies are still blinded every year.

Syphilis may be inherited or acquired. If inherited the sequence is usually as follows: The father has been infected and has been cured, as he thinks. He has not been under intelligent medical supervision. Probably he has had proper treatment for a short time and then has stopped going to the doctor. Or he has changed doctors frequently because he thought he was not getting results and has finally given up in disgust. Or he has pinned his faith to patent medicines, taking one after another, following the lure of specious advertisements. He enters the marital state unclean; the mother becomes infected and she unwittingly passes it on to the child, who—if it survives the first weeks or months of infancy—will carry the effects of an almost incurable disease as long as it lives.

Only compulsory reporting of venereal disease will lessen the evil. But in order to bring this about it must

be universally understood that reporting does not mean publicity. And infected persons should not be permitted to marry until they have been pronounced clean.

Here is another of the diseases that are both avoidable and unavoidable—pulmonary tuberculosis, commonly called consumption. Its victims of both sexes and all ages may be estimated by the tremendous number of men who were excluded for this cause from the Army—ninety-five thousand. Most people believe that the only way to prevent consumption is by keeping away from those who have it. But in spite of our precautions we are all exposed to it almost every day of our lives.

Why do we not all get it? The answer is that we have something within ourselves strong enough to antagonize it.

Pulmonary tuberculosis is probably the most feared of all diseases, for two reasons: We are afraid that we will get it from others, and we believe it to be fatal. Both fears are very largely baseless. The inevitability of death from consumption is a foolish belief and is rapidly disappearing. Even the consumptive himself soon learns that he has a good chance to conquer the disease and that he must help to make the chance a certainty.

But the other fallacy is harder to disprove. It must suffice to say that the preponderance of evidence is to the effect that in by far the greater number of instances adults infect themselves and do not get the disease from others; that all or nearly all of us are tuberculosis in that we harbor the germs and contend against them continually. Not that we all have active tuberculosis or consumption, but that the tubercle bacillus is within us, waiting its chance to set up housekeep-

ing in our weakest place, which in the majority of cases is the lungs.

This activation, when it occurs in the lungs, is what we know as pulmonary tuberculosis. Now, activation may be prevented by keeping well. That is, by keeping up or building up our resistance to the disease. But children, especially infants, have not been long enough in contact with the germs to have developed sufficient resisting power, and their resistance is more easily overcome. For this reason they should be removed from contact with those who have the active disease.

Is this clear? It may be simply stated thus: Infants and children are prone to get the disease from others, but adults with few exceptions get it because they already have the germs within them and their natural resistance has been broken down. Disease germs do not thrive in healthy bodies.

Now the tubercle bacillus is a minute vegetable, a living, rodlike organism so small that it must be magnified a thousand times in order to be seen at all. It multiplies by dividing, which sounds paradoxical. That is, one bacillus fully grown, and each of these into two and so on, which for a single germ would soon result in a family of many millions—under the most favorable conditions, however. But conditions are never absolutely favorable, and in the vast majority of cases they are extremely unfavorable for the germ.

Heart diseases surely belong to the unavoidable conditions? Not necessarily, but most people think so.

In the course of a casual conversation your friend says to you: "By the way, have you heard about Sallie Smith? She has heart trouble."

You shake your head sadly: "And with two little children!"

Just like that. As though you had been informed that Mrs. Smith's death warrant had been duly signed, leaving only the date space blank.

There are many kinds of heart disease, most of which are not fatal. Of one million men examined for the Army about 12,000 were rejected for conditions of the heart or blood vessels. But many times this number of men had heart conditions and were accepted as soldiers, because they had functional and not organic troubles. And it is quite reasonable to assume that the lives of one-half or perhaps three-quarters of those rejected were prolonged by the examinations simply because they learned about themselves.

If there is any one class of conditions in which ignorance is an especial danger it is conditions of the heart. The reason why some people die of heart disease is partly due to the fact that their attention has never been called to their condition until too late. It is only when the heart is almost completely broken down that we are conscious of it at all. There are no nerves of sensation in the heart muscle. The pains suffered are reflex or referred pains in other nerves, many of them quite remote, which are connected through the spinal cord with the motor nerves of the heart. Many pains which we call heart pains because they are in the chest wall near the heart really do not have their origin in the heart at all. And many a person dies of heart disease whose only symptom has been shortness of breath.

As has been said in a previous chapter the heart is a force pump, a great muscle or bundle of muscles which, by contracting, send the blood coursing through the vessels to the remotest parts of the body with such force that it flows back to the heart, to receive

a new impetus. It is not what is wrong with this pump, as with any other pump, which is most important. It is what the pump can do in spite of its defects, and especially what it cannot do. It is extremely necessary to give the pump no greater task than it can perform safely. Hence one must know where the dividing line is between work and overwork.

One of three things may be the fault in what is called heart disease. It may be the heart itself—that is, either the valves, the orifices through which the blood flows—or it may be the heart muscle. To carry on the analogy of a pump, it may not be the pump at all, but the piping system—that is, the blood vessels. Finally, it may be the pumper, or the force which causes the heart to pump—which is the nerve supply.

In case the piping system is at fault there may be an obstruction somewhere which hinders the onward flow of the blood, causing the heart to labor. This may become so great as to stop the heart action altogether.

The most frequent cause of obstruction to the stream is arteriosclerosis, or hardening of the vessel walls. This usually comes on with advancing age, but it may appear earlier under certain conditions. One of the theories of the cause of arteriosclerosis is based upon the extreme high pressure of modern life. We are a nation of fast livers, always hurrying, always driven by pressure from within. In the arterial walls are elastic and muscle fibers which lengthen and contract with each wave of the onward flowing blood. These degenerate with advancing years after continued high living and are replaced by inorganic matter which renders the artery walls hard and inelastic.

Now, it requires more force to pump fluid through a lead pipe than through a rubber hose, which by its own contractions helps to drive the stream onward. So hardening of the arteries compels stronger heart contractions and finally this overexertion may exhaust the heart altogether.

If the pumper is at fault, and not the pump or the vessels, the cause is elsewhere. Something is wrong with the nerve stimulus of the heart. The heart action may be too rapid—as for instance, from excitement or overexertion. It may be too slow, as in wasting diseases, or it may be irregular. Diseased conditions of the other organs may act reflexly upon the heart through the nerve centers and the heart itself not be at fault at all.

The practical application of all this is that one must learn the cause. If it is remote the cause must be corrected, if possible, and many so-called heart conditions will disappear. Many forms of heart manifestations may be prevented by proper care during the progress of other diseases. If the fault lies in the heart itself one must learn what can be done with safety. Get competent advice, not from your neighbor or your plumber, but from a physician, and then live it. Do not follow the example of the man who said that he would not pay for his doctor's advice because he did not intend to take it.

Above all, do not despair. Remember that a pump may perform its task with a leaking valve—if the pumper realizes the defect and pumps accordingly. But he must not attempt to pump to the point of exhaustion. Nor always at the same speed. Occasionally he must rest.

This is the end of the string of seven as set forth in the beginning, which were assembled here for the sole reason that the army examinations proved how much they make up the sum of human ills. If there is anything helpful in this chapter it will be by suggestion only, because lack of space does not permit exhaustive treatment, and many of these ailments have been discussed in previous chapters.

It is plain that any attempt to segregate these conditions into avoidable and into unavoidable is at least partly artificial. Not one of them in all circumstances belongs in either class. The important thing to know, however, is that those of us who are not already victims may avoid most of them if we choose, and that the dire consequences of every one of them may be averted.

Ignorance lies at the bottom of most of our physical ills—ignorance or willful carelessness. Many of us do what we know to be wrong, hoping some day to stop doing it before it is too late. Many of us hide our weaknesses, refusing to confide even in the doctor. Many of us get advice and, having received it, throw it away unused, which is far less sensible than dropping a newly purchased garment in the sewer on the way home from the store.

Many are held by the fear of an operation that may be far safer than doing without it. Many are lured by specious promises of patent-medicine manufacturers whose motive is to fill their pockets.

It takes moral courage to reckon up our physical liabilities, and many of us shrink from the attempt, postponing it fatally.

Even in the case of minor evils, which cause only

discomfort and lessen our efficiency, we go on suffering rather than take the time or the trouble to get rid of them.

These are days of business efficiency; why not practice a little personal efficiency with regard to our bodies?

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